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Systems

Reference Manual for IBM 3340/3344 Disk Storage

IBM

PREFACE

This publication is intended to familiarize data processing personnel with the characteristics of IBM 3340/3344 Disk Storage. The reader should have prior knowledge of direct-access storage devices and concepts.

This publication is organized by topics as follows:

- INTRODUCTION — Describes basic units and lists highlights and functions.
- CONFIGURATIONS and ATTACHMENTS — Defines some possible combinations and system attachments for the 3340/3344.
- FEATURES — Describes both standard and optional features available for the 3340/3344 with illustrations of some combinations.
- FORMATS — Describes and illustrates the record and track formats for data. Also provided are Record/Track capacity charts including formulas for capacity calculations of various length records.
- INPUT/OUTPUT — Includes addressing methods, access times, and identifies security and privacy means. Lists and summarizes the 3340/3344 command set and sense byte formats. Also includes an error condition table and the associated error recovery actions.
- OPERATING INSTRUCTIONS — Describes all switches and indicators associated with the 3340/3344 Operator and Power Panels. Provides suggested instructions for data module unloading and loading procedures and the Enable/Disable Read Only Function.

The following publications are recommended for detailed information concerning the subjects covered in this manual:

- *IBM System/370 Principles of Operation,* Order No. GA22-7000.
- *IBM 3348 Data Module Handling Procedures,* Order No. GA26-1625.
- *IBM 3340 Disk Storage Fixed Head Feature Users Guide,* Order No. GA26-1632.
- *IBM Reference Manual for Integrated Storage Control,* Order No. GA26-1620.
- *IBM Reference Manual for 3830 Model 2 Storage Control,* Order No. GA26-1617.
- *The Data Processing Glossary,* Order No. GC20-1699, defines terms related to direct-access storage devices.
- The functional characteristics manual applicable to the parent system. Order numbers for functional characteristics manuals can be found in the *IBM System/360 and System/370 Bibliography,* Order No. GA22-6822.

Fifth Edition (July 1975)

This publication replaces and makes *Reference Manual for IBM 3340 Disk Storage,* Order No. GA26-1619-3, obsolete.

Significant changes or additions to the specifications contained in this publication are continually being made. Before using this publication in connection with the operation of IBM equipment, contact the local IBM Branch Office for revisions.

Copies of this and other IBM publications can be obtained through IBM Branch Offices.

A form for reader's comments is provided at the back of this publication. If the form has been removed, send your comments to the address below.

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INTRODUCTION

The IBM 3340 Disk Storage provides direct-access storage for IBM System/370 Models 115, 125, 135, 145, 155-II, 158, 165-II, and 168. The 3340 consists of a Model A2, control with dual-drive disk storage, and up to three attached dual (B2) or single (B1) drive units. The 3344 large-capacity, dual-drive unit can be substituted for the 3340 B-type units on IBM System/370 Models 135, 145, 155-II, 158, 165-II, and 168.

The 3340/3344 is a modular, high-speed, large-capacity disk storage subsystem for data base, data communication, or general purpose use.

IBM 3340 DISK STORAGE

The IBM 3340 direct-access storage introduces two technological advances: a data module and defect skipping.

Data Module

The sealed data module cartridge contains storage disks, drive spindle, read and write heads, and access arms. The data module has several advantages over a disk pack:

- The drive data storage capacity can be changed by using a different data module.
- The heads, storage disks, and drive spindle are sealed inside the data module. This avoids contamination from outside sources and reduces preventive maintenance.
- Reliability is improved as each head reads only the data that it previously wrote.

Defect Skipping

Defect skipping allows data to be stored both ahead of and following a surface defect. All of the recording track can be used except for minute portions. Since the heads no longer need be moved to an alternate track, access time is saved.

Data module capacity is not changed by defect skipping and the user is unaware of defects.

IBM 3344-B2/B2F DISK STORAGE

The IBM 3344-B2/B2F dual-drive unit provides increased capacity, lower-cost-per-byte, direct access storage. Each 3344 drive stores four times the quantity of data of a 70-megabyte data module by using fixed media. The 3344 dual drives can replace the 3340 B-drives in a 3340 string on IBM System/370 Models 135, 145, 155-II, 158, 165-II, and 168. The 3344-B2F contains fixed head storage.

Defect skipping, similiar to that used on the 3340, is also used by the 3344-B2/B2F.

IBM 3340/3344 UNITS

The 3340/3344 disk storage is made up of a maximum of four dual-drives. The input/output interface is a 3340 Model A2 containing two independent drives and their control logic. Up to three additional attached dual-drives are controlled by the A2 unit.

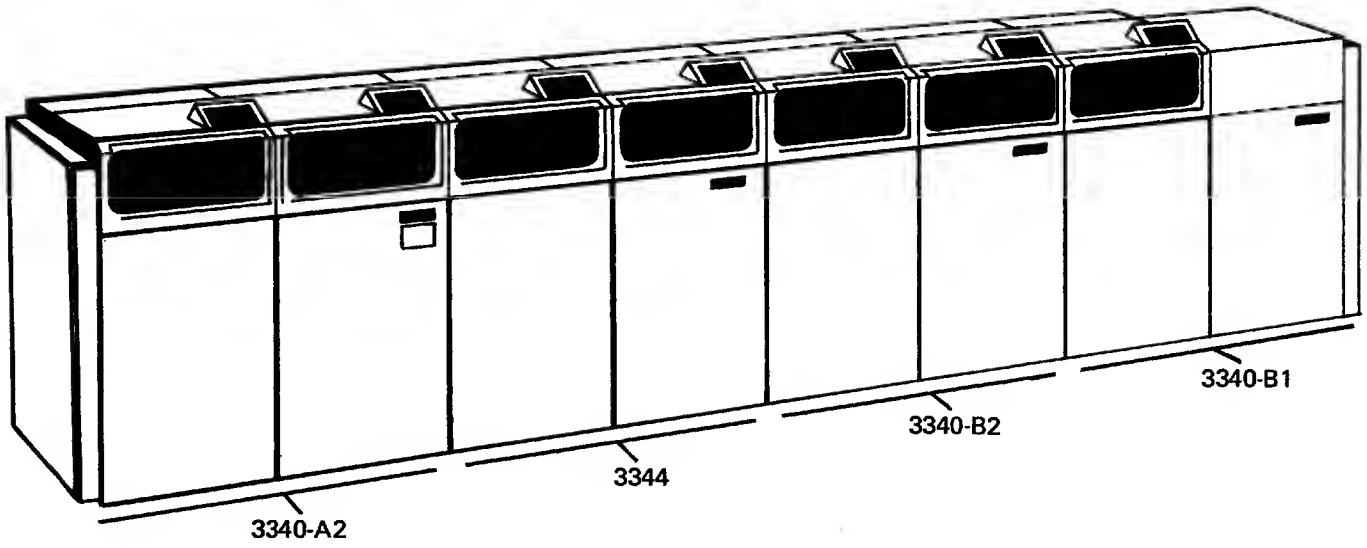
The 3340 Model B contains either one or two drive mechanisms. The Model B1 contains a single drive; the Model B2 contains two drives. Each model contains all necessary electronic and power supply circuits for internal use, but data control and power sequencing comes from the A2 unit.

The 3340 Models A2, B2, and B1 use the 3348 data module as a storage medium.

The 3344 dual-drive models use fixed media storage instead of a data module. The following characteristics apply to both storage device types except that the 3344 storage capacity is 279.5 million bytes-per-drive and start time is not significant because the storage is not moved.

The 3340/3344 offers the following:

- Start time - less than 20 seconds
- Average access time - 25 milliseconds
- Average rotational delay - 10.12 milliseconds
- Nominal read/write rate - 885,000 bytes-per second
- Data module capacity - 34,944,768 or 69,889,536 bytes



IBM 3340-A2 (Control and Two Drives)

CONTROL

- Interprets and executes macro-orders from the storage control
- Regulates the storage control and disk storage interfaces
- Serializes and deserializes data
- Checks data integrity by error detection and error correction analysis
- Furnishes status to the system
- Performs diagnostic evaluation of the 3340/3344 storage string

DRIVES

- Responds to commands from the 3340-A2 (controller)
- Houses, loads, filters, and drives a 3348 data module which has various capacities (Models 35, 70, and 70F)
- Positions access mechanism with voice-coil and maintains track following with electronic servo system
- Selects the head
- Reads or writes data
- Provides safety and servicing information for subsystem and system evaluation

IBM 3340-B1 (One Drive), IBM 3340-B2 (Two Drives), and IBM 3344 (Two Drives)

- Responds to commands from the 3340-A2 (controller)
- Positions access mechanism with voice-coil and maintains track following with electronic servo system
- Selects head
- Reads and writes data
- Provides safety and servicing information for subsystem and system evaluation

3340-B1 and 3340-B2: Houses, loads, filters, and drives the 3348 data module(s) of various storage capacities (Models 35, 70, and 70F).

3344-B2 and 3344-B2F: Houses, filters, and powers two fixed media drives. Each 3344 drive is equivalent in capacity and format to four logical 3348 Model 70 volumes, a total of 279.5 million bytes of data.

Figure 1. IBM 3340/3344 Disk Storage

3340/3344 STORAGE CONTROL AND FEATURES

STORAGE CONTROL DEVICES

The following storage control devices can accommodate 3340/3344 disk storage.

- 3830 Model 2 Storage Control.
- System/370 Models 158 and 168 Integrated Storage Control (ISC).
- System/370 Model 145 ISC.
- System/370 Model 145 Storage Control Frame 3345 Models 3, 4, and 5.
- System/370 Model 135 Integrated File Attachment (IFA).

SPECIAL FEATURES

The 3340 disk storage has four special features. The Model A2 can be supplied with the string switch and the remote switch. All 3340 models can be ordered with Rotational Position Sensing and Fixed Head Storage.

The 3344 disk storage has no special features, as Rotational Position Sensing is standard. Fixed Head Storage is available, but must be ordered by model. The 3344 Model B2F contains fixed head storage and the Model B2 does not.

String Switch

The string switch feature is installed on the 3340-A2 (controller). This feature permits the 3340 string to be dynamically shared by two storage control devices. The feature includes two interlocked Enable/Disable switches allowing the string to be dedicated to either storage control or accessible by each. A remote control switch permitting the switches to be activated from a 158 or 168 Multiprocessor is also available.

Rotational Position Sensing

The rotational position sensing (RPS) feature reduces the channel connection time required to search for a given record after the track and head have been selected. This feature (optional on the 3340, standard on the 3344) disconnects the drive from the channel and permits other channel operations to be performed during the time required for the spindle to bring the required record to the read/write head.

Additional details on RPS and its associated commands are found in the following publications:

- *Reference Manual for Integrated Storage Control,* Order No. GA26-1620.
- *Reference Manual for 3830-2 Storage Control,* Order No. GA26-1617.

Fixed Heads

The 3340 fixed head feature permits use of the 3348-70F data module on any 3340 drive. This 70-megabyte data module contains fixed heads in addition to the normal access heads. With these fixed heads, 500 thousand bytes of storage are available that have zero seek time. The feature does not increase data module storage, because an equivalent amount of storage under the moving heads becomes inaccessible.

The 3344-B2F dual-drive is also equipped with fixed head storage. In this model, both 3344 drives have 1.004 million bytes of zero seek time storage. This fixed head storage is associated only with the primary addresses on each 3344 drive (see Figures 2 and 3).

For further details on the fixed head feature and its usefulness to your storage application, contact your IBM sales representative or see the *Fixed Head Feature Users Guide,* Order No. GA26-1632.

CONFIGURATIONS

The various configurations of 3340/3344 disk storage are divided into two groups: configurations using only 3340 units, and configurations using a combination of 3340 and 3344 units. These attachment methods, listed by model, follow.

3340 STORAGE WITHOUT 3344

In some System/370 models, strings of 3330 and 3350 storage devices can be used in addition to the 3340s.

Model 115 (115DDA)

The Model 115 uses the Direct Drive Attachment (DDA) for storage control. Four drives can be attached: a 3340-A2 dual drive with control, and a 3340-B2 (dual) or B1 (single) drive.

Model 125 (125DDA)

The Model 125 uses the DDA for storage control and can attach one string of up to eight 3340 drives.

Model 135 (IFA)

The Model 135 uses the Integrated File Attachment (IFA) for storage control. Sixteen drives, two strings, a 3340 string and a string of either 3340 or 3333/3330 drives can be attached.

Models 135, 145, 155-II, 158, 165-II, and 168 (3830-2) Models 145, 158, and 168 (ISC)

Storage control for the models shown is either a 3830-2 or an Integrated Storage Control. The 3830-2 and each ISC path can attach up to 32 drives, four strings of 3333/3330s, 3340s, or 3350s in any combination.

3340/3344 CONFIGURATIONS

When the 3344 is used, neither 3333/3330 nor 3350 drives can be attached to the same storage control. A 3344 requires four logical addresses for each drive. Only the 135, 145, 155-II, 158, 165-II, and 168 support the 3344 dual drive.

Model 135 (IFA)

The Model 135 Integrated File Attachment has a maximum of 34 logical addresses. This allows two storage strings to be attached: a 3340 string and a 3340/3344 string (see Figure 2).

Models 135, 145, 155-II, 158, 165-II, and 168 (3830-2) Models 145, 158, and 168 (ISC)

Sixty-four logical addresses can be used by a 3830-2 or ISC path when a 3340/3344 configuration is attached. Two strings of 3340/3344s, a 3340 string, and a short string of four 3340 drives can be attached.

Figure 3 shows the maximum 3340/3344 configuration. Only strings 0 and 2 can incorporate the 3344 units. Each drive has the hexadecimal addresses assigned relative to the storage control as shown.

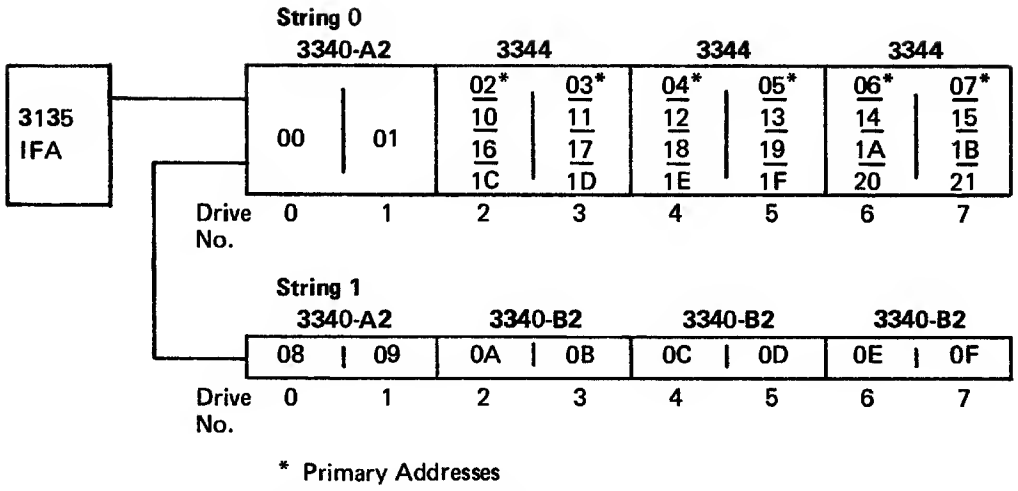


Figure 2. IFA 3340/3344 Maximum Configuration (Hexidecimal addressing)

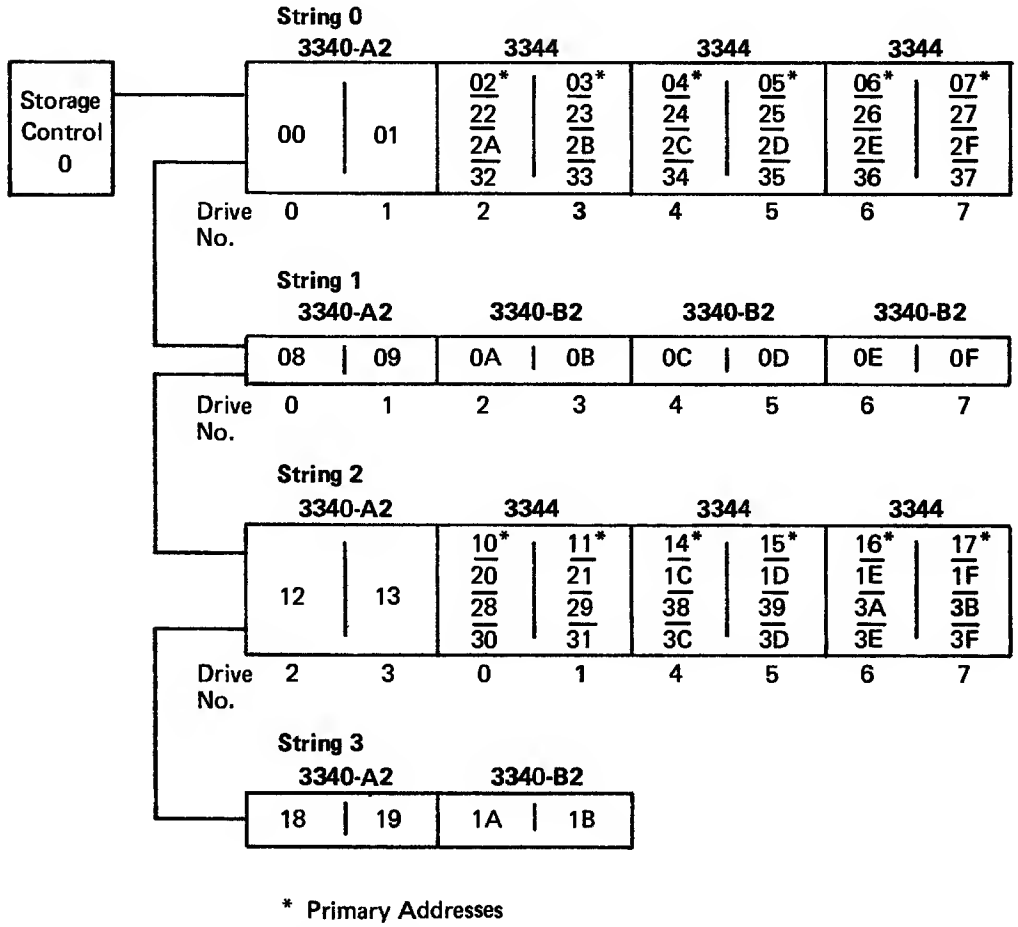
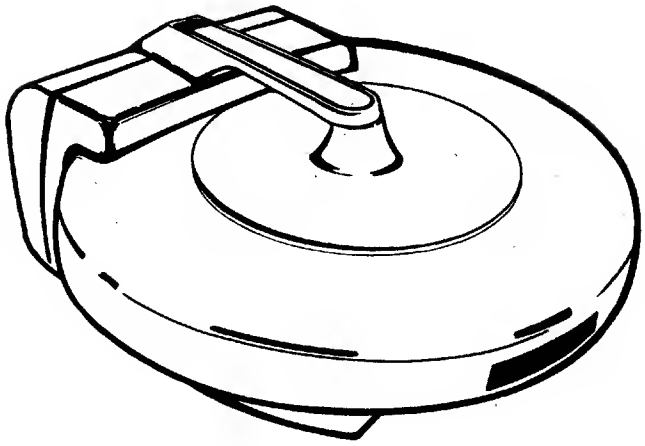


Figure 3. ISC or 3830-2 3340/3344 Maximum Configuration (Hexidecimal addressing)

IBM 3348 DATA MODULE



DATA MODULE TYPES

The 3340 models use the IBM 3348 Data Module as a storage medium. Three types are available: the 3348 Model 35 with about 35 million bytes of storage, the 3348 Model 70 with about 70 million bytes of storage, and the 3348 Model 70F with about 70 million bytes including one-half million bytes under fixed heads. The Models 35 and 70 can be freely exchanged on the 3340 drives, but the Model 70F can use its fixed heads only on 3340 drives that have been converted for Model 70F use.

The 3348-70F data module has the same characteristics as the 3348-70 except that cylinders 1 through 5 are accessed by the fixed heads. Data on tracks under the fixed heads is available with only rotational delay. The other tracks (cylinders 0 and 6 through 695) are subject to normal head access delays.

The three data modules have the following characteristics:

Byte Capacity	**3348-35**	**3348-70,-70F**
Per track	8,368	8,368
Per cylinder	100,416	100,416
Per module	34,944,768	69,889,536

DATA MODULE INITIALIZATION

All 3348 data modules are initialized when manufactured. Home address and 8-byte descriptors (R0) are written on each track. If a skippable defect is found, the written home address contains the skip displacement bytes. During normal operations the storage control uses the skip displacement bytes to bypass the defective area. If a module data area becomes defective during normal use, IBM utility programs are available to flag defective tracks and assign alternates if required (DASDR and ATLAS for OS and DASDI for DOS).

DATA SURFACE FORMAT

The disk data surface is divided into concentric bands of data called tracks (see Figure 4). Each data surface uses two magnetic read/write heads, one for the inside tracks and one for the outside tracks. The recording surface of the disk is divided in half. All odd numbered tracks are on one side of the dividing line and all even numbered tracks are on the other. The odd index point starts the odd tracks and the even index starts the even. When the heads are at a given position, they service four tracks: one odd, one even, one inside, and one outside.

In the 3348-35 data module the tracks under the three outside heads and those under the three inside heads form a cylinder. All odd numbered tracks are on one side of the three disks and the even tracks on the other side.

The 3348-70 data module contains four disks. The track geometry is the same as that of the smaller data module with a cylinder available at each position. Odd numbered cylinders are on the upper three surfaces and the even cylinders are on the lower three. From a single position two consecutive (even and odd) cylinders can be accessed (see Figure 5).

The differences between the storage media used on the 3340 data storage units follow:

	3348-35	**3348-70F 3348-70**
Data Surfaces per Module	2	2
Physical Heads per Surface	2	2
Logical Cylinders per Module	348	696
Alternate	1	2
CE	1	2
Logical Cylinders per Physical Cylinder	1	2
Physical Tracks per Physical Cylinder	6	12
Logical Tracks per Physical Cylinder	12	24
Logical Tracks per Logical Cylinder	12	12
Logical Tracks per Physical Track	2	2

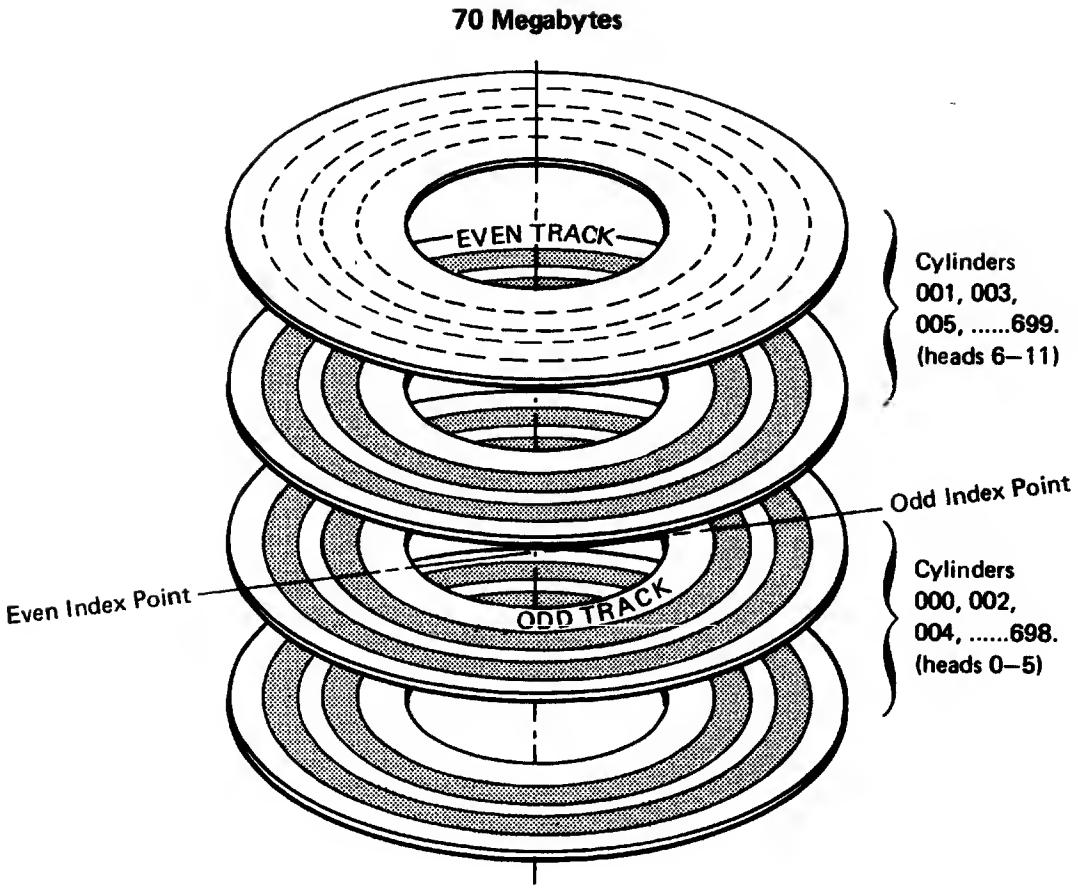
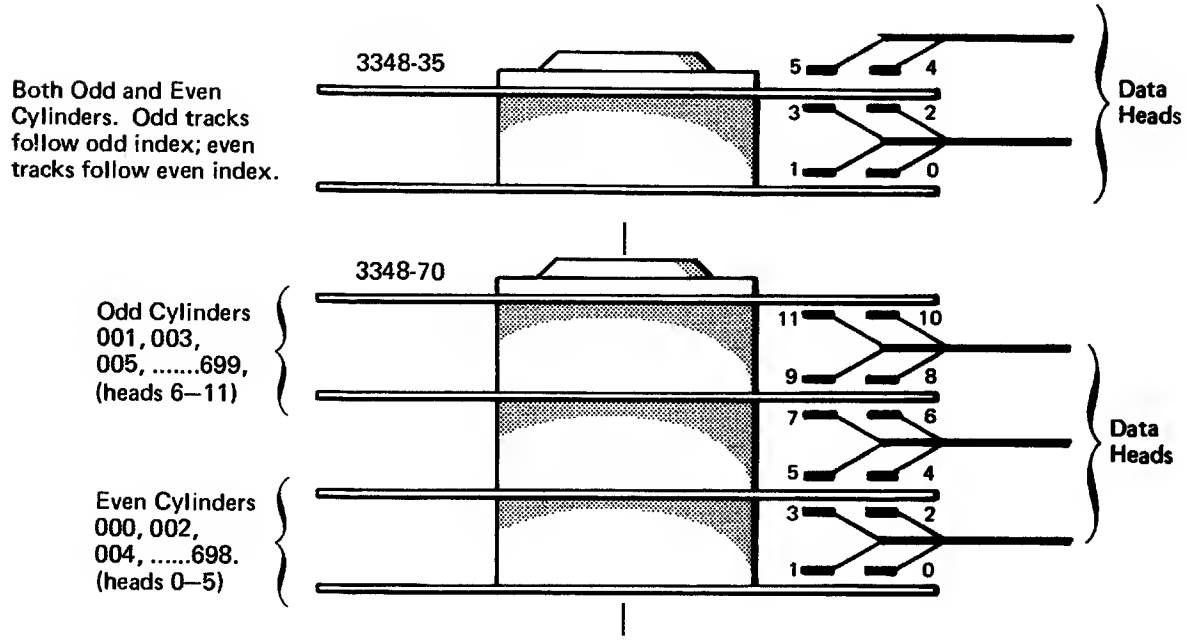


Figure 4. Data Surface Track Layout



Note: *In the 3348-70F data module, cylinders 001–005 are located on the bottom surface of the bottom disk.*

Figure 5. Data Module Geometry

FORMATS

RECORD FORMAT

The basic unit of information recorded by the drive is a byte consisting of eight bits. A group of bytes separated by a special gap is called an area. Areas are combined to make a record, the logical unit of information. A record consists of count, key, and data areas.

Count Area

The count area contains the location of a data record on a specific track and defines the size of the key and data areas of the record. The count area is written when the record is formatted and is not changed until the record is reformatted.

Key Area

Use of the key area is at the discretion of the programmer. When used, the key area of the record contains the primary identification of the data portion of the record (such as social security number, man number, part number).

Once the key area is formatted, the contents (but not the length) may be altered. If the key area is altered, the data area of the record must also be rewritten.

Data Area

The data area contains the information identified by the count and key areas of the record. Data information is organized and arranged by the programmer.

The length of the data area is defined by the count area. Once the data area is formatted, the contents (but not the length) may be altered. The contents of the data area may be altered without affecting any other area in the record.

TRACK FORMAT

All tracks are initially formatted beginning at an index point (see Figure 6). Each track has the same basic format: home address, track descriptor record, and one or more data records. The records, and areas within the records, are separated by gaps.

Home Address

Each track contains one home address, which defines the physical location of the track (track address) and the condition of the track. Home address is the first recorded area following an index point.

Specific commands are used for writing and reading a home address area: Write Home Address and Read Home Address. Home address is normally rewritten to flag the defective track. Writing home addresses is usually done at the IBM plant.

Track Descriptor Record (R0)

This record is always the first record on the track following the home address area. In IBM programming systems, the R0 count field of the defective track provides the address of the alternate track. If it is an alternate track, the R0 count area provides the address of the defective track. An 8-byte data field is used to store the number of bytes remaining on the track. Specific commands, Write R0 and Read R0, are used for writing and reading the track descriptor record.

Data Records

One or more data records may follow the track descriptor record (R0) on a track. Record format is determined at the time the count, key, and data areas of the record are originally written by execution of a Format Write command. The format of the record is rewritten by another Format Write command.

Data records, as well as track descriptor records, can be formatted with or without keys. Generally, file organization determines whether keys are used.

RECORD OVERFLOW

The record overflow function provides a means of processing logical records that exceed the capacity of a track. When using overflow records, the cylinder boundary limits the size of the record.

TRACK CAPACITY

The number of records that can be recorded on a track depends on the record size. The following equation can be used to determine the number of equal length records per track. The home address and standard R0 space and skip defect are taken into consideration.

$$\frac{\text{Equal length records}}{\text{track}} = \frac{8{,}535 \text{ (track capacity)}}{C + KL + DL \text{ (bytes/record)}}$$

where:

C(overhead/record)= 167 if KL = 0
= 242 if KL ≠ 0
KL= Key length
DL= Data length

The number of records *(n)* of different key and data lengths that can be recorded on a track must satisfy the following equation (the standard R0 is already accounted for):

$$\frac{\text{Records}}{\text{Track}} = 8{,}535 \geq \sum_{i=1}^{n} C + KL(i) + DL(i)$$

where:

C = 167 if KL = 0
C = 242 if KL ≠ 0

When R0 is not standard, the following formula should be used:

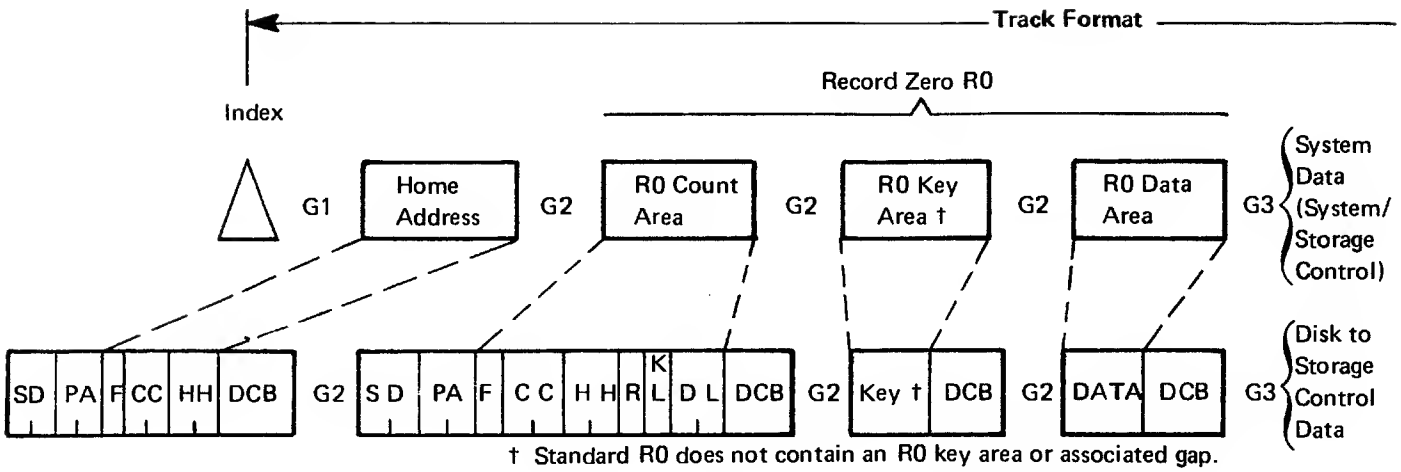
$$\frac{\text{Records}}{\text{Track}} = 8{,}706 \geq [KL(o) + DL(o) + C\text{–}4] + \sum_{i=1}^{n} [KL(i) + DL(i) + C]$$

where:

C = 167 if KL = 0
C = 242 if KL ≠ 0

The tables shown in Figures 7 through 10 give maximum sizes of *n* equal-length records on a track where *n* is all possible values. Track, cylinder, and data module capacities are given in both the number of bytes and the number of records.

There are tables for records without keys, and for records with keys. In all tables, overhead for home address and standard record zero (KL = 0, DL = 8) is already accounted for.



INDEX: Indicates the beginning of each track. All tracks on the disk surface are synchronized by Index.

G1 (Gap 1): Separates Index and Home Address.

HOME ADDRESS

SD (Skip Displacement): Storage control indicators for skip displacement condition of track.

PA (Physical Address): Storage control check for verification.

Note: *The SD and PA bytes are internal conventions involving only the storage control and drive. The function is transparent to the using system.*

F (Flag): Defines track condition as follows:

Bit 0 - Skip Displacement
Bits 1, 2, 4, and 5 — Unused.
Bits 6 and 7 — 00 = Normal Track
01 = Alternate Track
10 = } Defective Track
11 = }

The flag byte may be transferred to and from the using system. It is the only flag byte transferrable.

CC (Cylinder Number): Specifies the cylinder number:

For 3348-35 0 to 347
For 3348-70 0 to 695
For 3348-70F 0 to 695 (cylinders 1—5 fixed heads)

HH (Track Number): Specifies the read/write track number with the selected cylinder:

For 3348-35 0—11
For 3348-70 0—11
For 3348-70F 0—11 (cylinders 1—5 fixed heads)

DCB (Detection Code Bytes): Generated by the 3340-A2 and used for error detection.

Figure 6. Record and Track Format

G2 (Gap 2): Separates home address and R0 count area.

RECORD ZERO

R0 COUNT AREA

SD and PA: Same as Home Address.

F (Flag): Defines track condition identifier for overflow records.

Bits 0—2 — Skip Displacement Indicators.
Bits 3 and 5 — Unused, bit 5 is always zero.
Bit 4 — When on, indicates that a logical record continues on the next track.
Bits 6 and 7 — 00 = Normal Track
01 = Alternate Track
10 = } Defective Track
11 = }

CC (Cylinder Number): Specifies the cylinder number:

For 3348-35 0 to 347
For 3348-70 0 to 695
For 3348-70F 0 to 695 (cylinders 1—5 fixed heads)

HH (Track Number): Specifies the read/write track number within the selected cylinder.

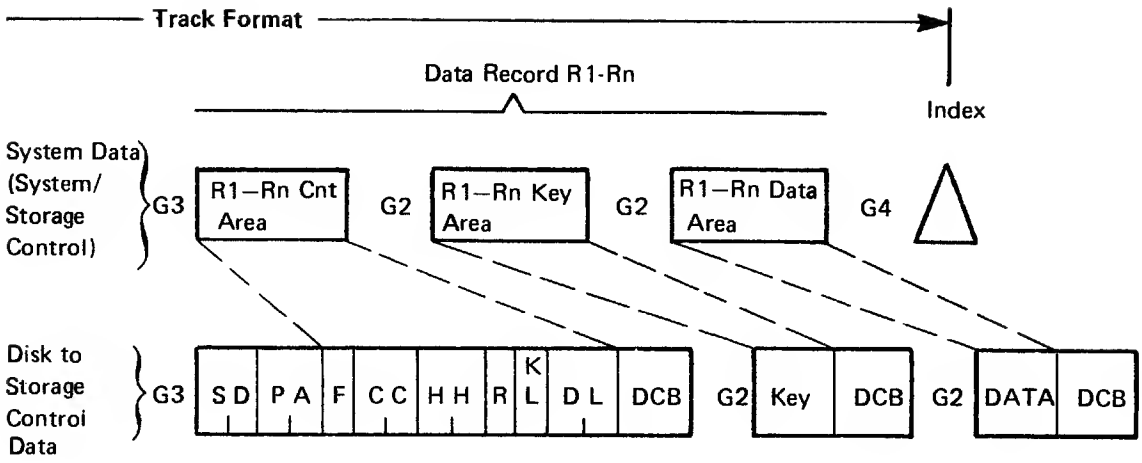
For 3348-35 0—11
For 3348-70 0—11
For 3348-70F 0—11 (cylinders 1—5 fixed heads)

R (Record Number): Normally has a value of Hex 00.

KL (Key Length): Specifies the number of bytes in the R0 key area, from 0—255 bytes. For standard R0, this normally has a value of Hex 00.

DL (Data Length): Specifies the number of bytes in the R0 data area, from 1 to track capacity. For standard R0, this normally has a value of Hex 08.

DCB (Detection Code Bytes): Generated by the 3340-A2 and used for error detection.



G2 (Gap 2): Precedes all key areas.

R0 KEY AREA

KEY AREA: Identifies information in the data area. For standard R0, this area is not present on the track.

DCB (Detection Code Bytes): If key area is written, these bytes are generated by the 3340-A2 and used for error detection.

G2 (Gap 2): Precedes all data areas.

R0 DATA AREA

DATA AREA: Contains the information identified by the count and key areas.

DCB (Detection Code Bytes): Generated by the 3340-A2 and used for error detection and correction.

DATA RECORD COUNT AREA (R1–Rn)

G3 (Gap 3): Precedes all count areas, except R0,

DATA RECORD

DATA RECORD COUNT AREA

F (Flag): Same as Record Zero.

CC (Cylinder Number): Specifies the cylinder number:

For 3348-35 0 to 347
For 3348-70 0 to 695
For 3348-70F 0 to 695 (cylinders 1-5 fixed heads)

HH (Track Number): Specifies the read/write track number within the selected cylinder:

For 3348-35 0–11
For 3348-70 0–11
For 3348-70F 0–11 (cylinders 1–5 fixed heads)

R (Record Number): Specifies the sequential number of the record on the track if specified by programmer.

KL (Key Length): Specifies the number of bytes in the key area, from 0–255 bytes.

DL (Data Length): Specifies the number of bytes in the data area, from 1 to track capacity.

DCB (Detection Code Bytes): Generated by the 3340-A2 and used for error detection.

G2 (Gap 2): Precedes all key areas.

DATA RECORD KEY AREA (R1–Rn)

KEY AREA: Identifies information in the data area.

DCB (Detection Code Bytes): Generated by the 3340-A2 and used for error detection.

G2 (Gap 2): Precedes all data areas.

DATA RECORD DATA AREA (R1–Rn)

DATA AREA: Contains the information identified by the count and key areas.

DCB (Detection Code Bytes): Generated by the 3340-A2 and used for error detection and correction.

G4 (Gap 4): Padding from end of the last data area to Index. If used for defect skipping, G4 is centered over the defect.

Record Length	Track Capacity		Cylinder Capacity	
(DL) (Bytes)	(Records)	(Bytes)	(Records)	(Bytes)
8,368	1	8,368	12	100,416
4,100	2	8,200	24	98,400
2,678	3	8,034	36	96,408
1,966	4	7,864	48	94,368
1,540	5	7,700	60	92,400
1,255	6	7,530	72	90,360
1,052	7	7,364	84	88,368
899	8	7,192	96	86,304
781	9	7,029	108	84,348
686	10	6,860	120	82,320
608	11	6,688	132	80,256
544	12	6,528	144	78,336
489	13	6,357	156	76,284
442	14	6,188	168	74,256
402	15	6,030	180	72,360
366	16	5,856	192	70,272
335	17	5,695	204	68,340
307	18	5,526	216	66,312
282	19	5,358	228	64,296
259	20	5,180	240	62,160
239	21	5,019	252	60,228
220	22	4,840	264	58,080
204	23	4,692	276	56,304
188	24	4,512	288	54,144
174	25	4,350	300	52,200
161	26	4,186	312	50,232
149	27	4,023	324	48,276
137	28	3,836	336	46,032
127	29	3,683	348	44,196
117	30	3,510	360	42,120
108	31	3,348	372	40,176
99	32	3,168	384	38,016
91	33	3,003	396	36,036
84	34	2,856	408	34,272
76	35	2,660	420	31,920
70	36	2,520	432	30,240
63	37	2,331	444	27,972
57	38	2,166	456	25,992
51	39	1,989	468	23,868
46	40	1,840	480	22,080
41	41	1,681	492	20,172
36	42	1,512	504	18,144
31	43	1,333	516	15,996
26	44	1,144	528	13,728
22	45	990	540	11,880
18	46	828	552	9,936
14	47	658	564	7,896
10	48	480	576	5,760
7	49	343	588	4,116
3	50	150	600	1,800

Figure 7. Record Capacities per Track and Cylinder – Without Keys

MODEL 35		MODEL 70/70F	
Records	Bytes	Records	Bytes
4,176	34,944,768	8,352	69,889,536
8,352	34,243,200	16,704	68,486,400
12,528	33,549,984	25,056	67,099,968
16,704	32,840,064	33,408	65,680,128
20,880	32,155,200	41,760	64,310,400
25,056	31,445,280	50,112	62,890,560
29,232	30,752,064	58,464	61,504,128
33,408	30,033,792	66,816	60,067,584
37,584	29,353,104	75,168	58,706,208
41,760	28,647,360	83,520	57,294,720
45,936	27,929,088	91,872	55,858,176
50,112	27,260,928	100,224	54,521,856
54,288	26,546,832	108,576	53,093,664
58,464	25,841,088	116,928	51,682,176
62,640	25,181,280	125,280	50,362,560
66,816	24,454,656	133,632	48,909,312
70,992	23,782,320	141,984	47,564,640
75,168	23,076,576	150,336	46,153,152
79,344	22,375,008	158,688	44,750,016
83,520	21,631,680	167,040	43,263,360
87,696	20,959,344	175,392	41,918,688
91,872	20,211,840	183,744	40,423,680
96,048	19,593,792	192,096	39,187,584
100,224	18,842,112	200,448	37,684,224
104,400	18,165,600	208,800	36,331,200
108,576	17,480,736	217,152	34,961,472
112,752	16,800,048	225,504	33,600,096
116,928	16,019,136	233,856	32,038,272
121,104	15,380,208	242,208	30,760,416
125,280	14,657,760	250,560	29,315,520
129,456	13,981,248	258,912	27,962,496
133,632	13,229,568	267,264	26,459,136
137,808	12,540,528	275,616	25,081,056
141,984	11,926,656	283,968	23,853,312
146,160	11,108,160	292,320	22,216,320
150,336	10,523,520	300,672	21,047,040
154,512	9,734,256	309,024	19,468,512
158,688	9,045,216	317,376	18,090,432
162,864	8,306,064	325,728	16,612,128
167,040	7,683,840	334,080	15,367,680
171,216	7,019,856	342,432	14,039,712
175,392	6,314,112	350,784	12,628,224
179,568	5,566,608	359,136	11,133,216
183,744	4,777,344	367,488	9,554,688
187,920	4,134,240	375,840	8,268,480
192,096	3,457,728	384,192	6,915,456
196,272	2,747,808	392,544	5,495,616
200,448	2,004,480	400,896	4,008,960
204,624	1,432,368	409,248	2,864,736
208,800	626,400	417,600	1,252,800

Figure 8. Record Capacities per Data Module – Without Keys

Record Length	Track Capacity		Cylinder Capacity	
(KL+DL) (Bytes)	(Records)	(Bytes)	(Records)	(Bytes)
8,293	1	8,293	12	99,516
4,025	2	8,050	24	96,600
2,603	3	7,809	36	93,708
1,891	4	7,564	48	90,768
1,465	5	7,325	60	87,900
1,180	6	7,080	72	84,960
977	7	6,839	84	82,068
824	8	6,592	96	79,104
706	9	6,354	108	76,248
611	10	6,110	120	73,320
533	11	5,863	132	70,356
469	12	5,628	144	67,536
414	13	5,382	156	64,584
367	14	5,138	168	61,656
327	15	4,905	180	58,860
291	16	4,656	192	55,872
260	17	4,420	204	53,040
232	18	4,176	216	50,112
207	19	3,933	228	47,196
184	20	3,680	240	44,160
164	21	3,444	252	41,328
145	22	3,190	264	38,280
129	23	2,967	276	35,604
113	24	2,712	288	32,544
99	25	2,475	300	29,700
86	26	2,236	312	26,832
74	27	1,998	324	23,976
62	28	1,736	336	20,832
52	29	1,508	348	18,096
42	30	1,260	360	15,120
33	31	1,023	372	12,276
24	32	768	384	9,216
16	33	528	396	6,336
9	34	306	408	3,672

Figure 9. Record Capacities per Track and Cylinder – With Keys

MODEL 35		MODEL 70/70F	
Records	Bytes	Records	Bytes
4,176	34,631,568	8,352	69,263,136
8,352	33,616,800	16,704	67,233,600
12,528	32,610,384	25,056	65,220,768
16,704	31,587,264	33,408	63,174,528
20,880	30,589,200	41,760	61,178,400
25,056	29,566,080	50,112	59,132,160
29,232	28,559,664	58,464	57,119,328
33,408	27,528,192	66,816	55,056,384
37,584	26,534,304	75,168	53,068,608
41,760	25,515,360	83,520	51,030,720
45,936	24,483,888	91,872	48,967,776
50,112	23,502,528	100,224	47,005,056
54,288	22,475,232	108,576	44,950,464
58,464	21,456,288	116,928	42,912,576
62,640	20,483,280	125,280	40,966,560
66,816	19,443,456	133,632	38,886,912
70,992	18,457,920	141,984	36,915,840
75,168	17,438,976	150,336	34,877,952
79,344	16,424,208	158,688	32,848,416
83,520	15,367,680	167,040	30,735,360
87,696	14,382,144	175,392	28,764,288
91,872	13,321,440	183,744	26,642,880
96,048	12,390,192	192,096	24,780,384
100,224	11,325,312	200,448	22,650,624
104,400	10,335,600	208,800	20,671,200
108,576	9,337,536	217,152	18,675,072
112,752	8,343,648	225,504	16,687,296
116,928	7,249,536	233,856	14,499,072
121,104	6,297,408	242,208	12,594,816
125,280	5,261,760	250,560	10,523,520
129,456	4,272,048	258,912	8,544,096
133,632	3,207,168	267,264	6,414,336
137,808	2,204,928	275,616	4,409,856
141,984	1,277,856	283,968	2,555,712

Figure 10. Record Capacities per Data Module – With Keys

INPUT/OUTPUT OPERATIONS

This section contains a general description of I/O operations used with IBM disk storage devices. Detailed information about the central processing unit and channel program control of I/O operations is found in *IBM System/370 Principles of Operation,* Order No. GA22-7000.

DEVICE SELECTION AND ADDRESSING

Device Address

3340 DRIVES

Drive addresses are specified in the I/O instruction. The 3340 address is specified in bits 4, 5, 6, and 7 of the address byte (byte 3); bit 3 is also used with 32 drive addressing.

Any drive address from hex 0 to F can be accepted. Drives 0 to 7 are attached to the first controller string and drives 8 to F on the second string. If a logical connection cannot be made because the required drive is offline, Unit Check (Intervention Required) is returned. If multiple selection is detected because of a hardware failure, Unit Check (Intervention Required) is returned.

Note: *The drive addresses must be wired on a logic board in the drive units.*

3344 DRIVES

For configurations using 3344 drives, the device addressing is modified to handle the multiple logical devices on each spindle. Bits 2 through 7 of byte 3 specify the logical device (a maximum of 64) and bits 0 and 1 the storage control address. This addressing allows 3344 drives on strings 0 and 2 only. String 3 can have only two 3340 units, one A2 and one B (see Figure 3). When 3344 drives are attached to a storage control, only 3340/3344 devices can be controlled; 3330 or 3350 strings cannot be attached.

Seek Address

A specific track is selected by sending the seek address and a Seek command to the required drive. These and other commands are described in the ISC and 3830-2 reference manuals.

Bytes 0 and 1 are unused, bytes 2 and 3 are the logical cylinder address, and bytes 4 and 5 are the logical track address. All seek addresses consist of six bytes.

0	1	2	3	4	5
0	0	C	C	H	H

The CCHH part of count areas and home addresses normally corresponds to bytes 2 through 5 of the seek address. The physical address (PA) bytes in each count area and home address indicate physical cylinder and track addresses. The PA bytes are written by the storage control and are used for seek verification.

When the seek argument is received by the storage control, it is converted into physical cylinder and track addresses and sent to the selected drive for Seek operations. The acceptable seek addresses for the 3340/3344 devices are:

Storage Model	Data Tracks		Alternate Tracks	
	CC	HH	CC	HH
3348-35	0 – 347	0 – 11	348	0 – 11
3348-70 3348-70F	0 – 695	0 – 11	696,697	0 – 11
3344-B2 3344-B2F	0 – 695 X4	0 – 11	696,697 X4	0 – 11

ACCESS AND DATA TRANSFER SPEED

The total time required for access and data transfer consists of access motion, head selection, rotational delay, and data transfer.

Access Motion Time

Access motion time is the time required to move the read/write heads to the correct cylinder. If the heads are already at the correct cylinder, the access time is zero. Access time is also zero for data stored under fixed heads when fixed head models are used.

If the access mechanism must move to another cylinder, a minimum of 10 milliseconds is required. The maximum access movement is 50 milliseconds, but the average access time is 25 milliseconds.

Head Selection Time

The time required to select the read/write head is negligible.

Rotational Delay

Rotational delay is the time required for the desired record area to reach the read/write head so that data transfer can begin. This time can range from zero to almost a full revolution. Half a revolution (average rotational delay) is generally used for timing purposes. The maximum and average rotational delays for 3340/3344 drives are:

Maximum rotational delay = 20.24 milliseconds

Average rotational delay = 10.12 milliseconds

Note: *Use of the Rotational Position Sensing feature minimizes the effect of rotational delay by permitting the drive to disconnect from the channel, thereby allowing use of other drives during a latency period.*

Data Transfer

Nominal read/write rates for the disk drives are:

Bytes-per-second = 885,000
Microseconds-per-byte = 1.13

DATA SECURITY AND PRIVACY

The 3340 and 3344 have a Read Only function. This function, in conjunction with previous methods such as File Protect and Seek Verification, offer a means of limiting access to data areas of the data module.

Read Only Function

3340 MODELS

The Read Only function provides the means for protecting designated data modules from being rewritten or erased.

Each data module is equipped with an inset in the handle. The operator can change the inset position before inserting the data module in the drive.

Note: *This insert is only accessible when the data module is not on the drive (see the "Operating Instructions" section).*

When the Read Only option is made, any Write command addressed to the drive is rejected. Subsequent sense information indicates Command Reject (byte 0, bit 0) and Write Protect (byte 1, bit 6).

3344 MODELS

In the 3344 dual-drive models, the Read Only function is controlled by a switch on the operator panel for each drive.

File Protection

Control of Write and Seek commands within a program can be affected by the Set File Mask command. A description of the Set File Mask command is given in the ISC and 3830-2 reference manuals.

By entering a Set File Mask, selected Write and Seek commands can be inhibited even though they appear in the command chain.

Seek Verification

The 3340/3344 track format includes two bytes in each count area and home address (physical address, PA) for seek verification. When a count area or home address is processed during Read, Search, or Clock operations, the bytes are compared with the most recent seek address. A non-compare results in termination of the operation at the end of the count area or home address with channel end, device end, and unit check. Seek check is also indicated in the sense information.

ERROR RECOVERY PROCEDURE

Error handling usually involves storage control and system-invoked recovery actions. These recovery actions can vary depending on how and to what system the 3340/3344 is attached.

The following topics are associated with recovery actions involving the 3830 Model 2, or ISC (storage controls), and the 3340/3344:

- Error Correction Function
- Error Condition Table
- Errory Recovery Action

ERROR CORRECTION FUNCTION

The error correction function (ECF) is part of the recovery action procedure. The ECF algorithms and the related procedure are fully described in the 3830 Model 2 and ISC reference manuals.

ERROR CONDITION TABLE

The Error Condition Table (Figure 11) identifies unique configurations of sense bits set by the storage control in sense bytes 0, 1, and 2. In addition, it refers to each of these configurations in a specific recovery action to be invoked by the system.

ERROR RECOVERY ACTION

The 3340/3344 Recovery Action Table (Figure 12) specifies actions to be taken for error conditions listed in the Error Condition Table. A necessary part of the recovery action is the construction of Restart Channel Command Words 1 and 2.

Construction of Restart CCWs

If Operation Incomplete (byte 1, bit 7) is set in the sense information, it indicates that an error or unusual condition occurred during a logical operation after data transfer had been initiated. By constructing Restart Channel Command Words, the error recovery procedures can correct the unusual condition and continue the operation in progress from the point of interruption to the normal ending point.

RESTART CCW 1

Restart CCW 1 is constructed as follows:

1. The command code byte is provided in sense byte 3.
2. The data address is that of the interrupted CCW, plus the count of that CCW, minus the residual count in the channel status word (CSW).
3. The flags, except Program Controlled Interrupt (PCI), are those of the interrupted CCW.
4. The count is the residual count in the CSW. If the residual count is zero, a count of one must be used. If a Write command is in progress, the data address should specify a byte containing '00'. If a Read command is in progress, turn on the skip bit.

RESTART CCW 2

Restart CCW 2 is constructed as follows:

1. The command code is provided in sense byte 3.
2. The count is constructed as follows:
   a. Fetch the count of the CCW designated by CSW-8, and set a pointer to this CCW.
   b. Subtract the restart displacement from the count obtained in step a. If this result is positive, go to step f; otherwise go to step c.
   c. Check the chain data flag of the CCW designated by the pointer. If the flag is not set, go to step e; otherwise go to step d.
   d. Advance the pointer to the next non-Transfer in Channel (non-TIC) CCW in the data chain and add the count of this CCW to the counts of all preceding non-TIC CCWs in the data chain. Return to step b.
   e. Truncation occurs. Set the restart CCW 2 count equal to 1. Go to step 3 and include the skip bit in the Restart CCW flags.
   f. Set the Restart CCW 2 count equal to the result of the subtraction in step b. Go to Step 3.

3. The flags (except PCI) are those of the CCW designated by the pointer in Step 2. The skip bit is also set if Step 2e was previously executed.
4. The data address is that of the CCW designated by the pointer in Step 2, plus the count of that CCW, minus the Restart CCW count generated in Step 2.

If another Operation Incomplete occurs while executing the Restart CCW, a new Restart CCW may be generated from the old Restart CCW.

Note: *Be sure to avoid destroying the old Restart CCW before generating the new one.*

3340/3344 Error Condition Table					
Byte	Bit	Name	General Description	Action	Logged
0	0	Command Reject	Programming error.	1	No
0	1	Intervention Required	Drive offline, Not Ready, CE Mode, or data module incompatability such as a 3348-70F installed on a drive that does not have the Fixed Head feature.	1	Yes
0	2	Bus Out Parity	Bus Out parity error.	3	Yes
0	3	Equipment Check	Equipment malfunction.	4	Yes
0	4	Data Check	Data check in home address, count area, or key area; or uncorrectable data check in data area.	4	Yes
0	5	Overrun	Service overrun or command overrun.	4	Yes
0	6	Track Condition Check	Non-home address or record 0 commands for a defective track or any multitrack commands switching from a known alternate or defective track.	5	No
0 1	6 7	Track Condition Check Operation Incomplete	Switching from alternate track during overflow record processing or switching to a defective track during overflow record processing.	9	No
0	7	Seek Check	Seek incomplete or incorrect physical address when reading home address or count area.	6	Yes
0 2	4 1	Data Check Correctable	Correctable data check in a non-multitrack data area or the data area of the last overflow segment.	7	Yes
0 2 1	4 1 7	Data Check Correctable Operation Incomplete	Correctable data check in data area of overflow segment is not the last segment.	8	Yes
0 2 1 0	4 1 7 6	Data Check Correctable Operation Incomplete Track Condition Check	Correctable data check in the data area of an overflow segment (not the last segment) of an alternate track	8A	Yes
0 1	0 6	Command Reject Write Inhibit	A Write command received with the selected drive in the write inhibit state.	1	No
1	1	Invalid Track Format	Track capacity exceeded.	2	No
1	2	End of Cylinder	Cylinder boundary detected during a basic multitrack operation.	10	No
1 1	2 7	End of Cylinder Operation Incomplete	Cylinder boundary detected during a basic overflow operation.	11	No
1	4	No Record Found	Programming error or expected programming error condition. The searched data does not exist on that track.	2	No
1	5	File Protected	The Seek command or Read/Search multitrack operation violated file mask.	12	No
1 1	5 7	File Protected Operation Incomplete	A Read or Write Overflow operation violated file mask.	13	No
2	3	Environmental Data Present	Statistical usage/error log information is present.	3	Yes

Figure 11. Error Condition Table

3340/3344 Recovery Action Table	
Action	**Explanation**
1	Print message 1 for operator and/or customer engineer notification.
2	Exit with programming error or unusual condition indication.
3	a. Repeat the operation one time. b. If the error condition persists, perform Action 1.
4	a. Repeat the operation. b. If the error condition persists after ten retries, perform Action 1.
5	a. If this is a defective track, perform Action 5A. b. Use address of defective track plus 1 in a Seek command. The defective track address can be found in the ID area of the record 0 count area. c. Resume operation after searching to desired track position.
5A	a. Use address of alternate track in a Seek command. The alternate track address can be found in the ID area of the record 0 area. b. Resume operation after searching to desired track position.
6	a. Issue a Recalibrate command. b. Seek to the original address. c. Perform Action 4.
7	a. Perform error correction function. b. Examine bit 7 of the file mask. If this bit is off, go to step c. If this bit is on, return to user with indication that data has been corrected. (User is operating in PCI fetch mode and must, therefore, supply restart recovery action.) *Note: Only applies with OS/360.* c. If the user's chain has not been completed, examine the next non-TIC command in the user's chain. If bit 3 of this command is on (count area), go to step d. If bit is off, perform Action 7A. *Note: If data chaining is indicated in the interrupted CCW, the preceding test must be executed on the first non-TIC CSW after the last CCW in the data chain.* d. Continue the user's chain by executing the following CCW chain: Seek (same as original)† Set File Mask (same as original) Read Home Address (skip bit on) Search ID Equal (CCHHR provided in sense bytes 8-12) TIC* −8 TIC (channel status word)
7A	Continue the user's chain by executing the following command chain: Seek (same as original)† Set File Mask (same as original) Read Home Address (skip bit on) Search ID Equal (CCHHR provided in sense bytes 8-12) TIC* −8 Read Count (skip bit on) TIC (channel status word)

† *Cylinder bytes and the high-order head byte are obtained from the user. The low-order head byte is obtained from bits 3 through 7 of sense byte 6.*

Figure 12. Recovery Action Table (1 of 4)

3340/3344 Recovery Action Table (continued)	
Action	**Explanation**
8	a. Perform error correction function. b. Examine bit 7 of the file mask. If this bit is off, go to step c. If this bit is on, return to user with indication that data has been corrected. (User is operating in PCI fetch mode and must supply restart recovery action.) *Note: Only applies with OS/360.* c. Increment the seek argument by one. Cylinder bytes and the high-order head byte are obtained from the user. The low-order head byte is obtained from bits 3 through 7 of sense byte 6. d. Construct Restart CCW 2. e. Complete the interrupted operation and continue the user's chain (if appropriate) by executing the following command chain. Seek (argument from step c)† Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) TIC* −8 Restart CCW 2 TIC (channel status word) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
8A	a. Perform error correction function. b. Examine bit 7 of the file mask. If this bit is off, go to step c. If this bit is on,return to user with indication that data has been corrected. (User is operating in PCI fetch mode and must supply restart recovery action). *Note: Only applies with OS/360.* c. Use address of the defective track plus 1 in the Seek command. d. Construct Restart CCW 2. e. Complete the interrupted operation and continue the user's chain (if appropriate) by executing the following command chain. Seek (argument from step c) † Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) TIC* −8 Restart CCW 2 TIC (channel status word) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*

† *Cylinder bytes and the high-order head byte are obtained from the user. The low-order head byte is obtained from bits 3 through 7 of sense byte 6.*

Figure 12. Recovery Action Table (2 of 4)

3340/3344 Recovery Action Table (continued)	
Action	**Explanation**
9	a. If this is a defective track, perform Action 9A. b. Use address of defective track plus 1 in a Seek command and use the following CCW chain to resume operation. Seek Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) TIC* −8 Restart CCW 1 TIC (channel status word) *Note: If the modifier seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
9A	a. Use address of alternate track in Seek command in the following CCW chain. Seek Set File Mask (inhibit seeks) Set Sector (argument 0) Search ID Equal (record 1) TIC* −8 Restart CCW 1 TIC (channel status word)
10	a. Increment the cylinder address of the user's seek argument by one. Reset the head address. b. Continue the operation by executing the following command chain: Seek (argument from step a) Set File Mask (same as original) Set Sector (argument 0) Read Home Address (skip bit On) TIC (channel status word - 8) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
11	a. Increment the cylinder address of the user's seek argument by one. Reset the head address. b. Construct Restart CCW 1. c. Complete the interrupted operation and continue the user's chain (if appropriate) by executing the following command chain. Seek (argument from step a) Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) TIC* −8 Restart CCW 1 TIC (channel status word) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*

Figure 12. Recovery Action Table (3 of 4)

3340/3344 Recovery Action Table (continued)	
Action	**Explanation**
12	a. Determine if the interrupted command is a Seek. If yes, go to step b. If no, perform Action 12A. b. Continue the operation by executing the following command chain: Seek (same as original)† Set File Mask (same as original) Set Sector (argument 0) Read Home Address (skip bit on) TIC (channel status word) *Note: If the seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
12A	a. This is a multitrack operation. Increment the user's seek argument by one. b. Continue the operation by executing the following command chain: Seek (argument from step a) Set File Mask (same as original) Set Sector (argument 0) Read Home Address (skip bit on) TIC (channel status word–8) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
13	a. Increment the user's seek argument by one. b. Construct Restart CCW 1. c. Complete the interrupted operation and continue the user's chain (if appropriate) by executing the following command chain: Seek (argument from step a) Set File Mask (same as original) Set Sector (argument 0) Search ID Equal (record 1) Search ID Equal (record 0) TIC* –8 Restart CCW 1 TIC (channel status word) *Note: If the modified seek argument is not within the user's extent, then IOS must supply the correct seek argument before issuing the seek. If that is impossible, then IOS must perform Action 2.*
Message Message 1 (should be printed on all permanent errors). a. Message Code. b. Error type (read, write, or control). c. Module designation, cylinder number, and head number (that is, device address and seek address). d. Channel designation. e. Status and sense bytes sent to CPU.	

† *Cylinder bytes and the high-order head byte are obtained from the user. The low-order head byte is obtained from bits 3 through 7 of sense byte 6.*

Figure 12. Recovery Action Table (4 of 4)

CHANNEL COMMANDS

The command set used to perform operations with the 3340/3344 is as follows:

SENSE COMMANDS

- Sense I/O
- Read and Reset Buffered Log
- Test I/O
- Read Diagnostic Status

CONTROL COMMANDS

- No Operation
- Seek
- Seek Cylinder
- Seek Head
- Recalibrate
- Restore (executed as a no-operation)
- Set File Mask
- Space Count
- Set Sector
- Diagnostic Load
- Diagnostic Write
- Device Release
- Device Reserve

For more detailed information on the commands refer to the ISC and 3830-2 reference manuals. Each of the commands is briefly summarized in the charts on the following pages.

READ COMMANDS

- Read Data
- Read Key and Data
- Read Count, Key, and Data
- Read Multiple Count, Key, and Data
- Read Home Address
- Read Count
- Read Initial Program Load
- Read Sector
- Read Record Zero

WRITE COMMANDS

- Write Data
- Write Key and Data
- Write Count, Key, and Data
- Write Home Address
- Write Record Zero
- Write Special Count, Key, and Data
- Erase

SEARCH COMMANDS

- Search ID Equal
- Search Key Equal
- Search Home Address Equal
- Search ID High
- Search Key High
- Search ID Equal or High
- Search Key Equal or High

SENSE COMMANDS

Command	Code		Function	Data Transferred Across Channel
	Single Track	Multi-track		
Test I/O (See Note 1)	00	–	Determines the status of a device on a channel. Generated automatically by the channel when status information is required.	One status byte.
Sense I/O (See Note 2)	04	–	Determines the type of error or unusual condition that caused the last unit check.	24 bytes of sense information.
Diagnostic Sense (See Note 3)	44	–	Determines the type of error(s) found on running a diagnostic test (part of a Diagnostic Write command) or transfers a diagnostic test from the storage control unit to the system (after a Diagnostic Load command).	16 bytes of error code message or 512 bytes of diagnostic test data.
Read and Reset Buffered Log (See Note 4)	A4	–	Supplies usage or error statistics on the addressed drive.	24 bytes of usage and overrun error information.

Note 1: Test I/O is not a 3340/3344 command, but rather a system command similar to Start I/O. Command code (0000 0000) is not written by the programmer.

Note 2: Sense data is reset after transfer.

Note 3: If the command is not preceded by a Diagnostic Write or Load command, 16 bytes of data from the error code message area are transferred.

Note 4: Data is reset after transfer.

CONTROL COMMANDS

Command	Code	Function	Data Transferred Across Channel
No Operation	03	No action. Channel End and Device End are presented during initial status.	None
Seek	07	1. Selects drive. 2. Moves the access to the cylinder specified by the seek address. 3. Selects the head specified by the seek address.	Seek address (six bytes)
Seek Cylinder	0B		
Space Count	0F	When chained from a Read, Search, Write or Space Count command, this command locates the start of the next count area (including R0), spaces over the count area, and ends with Channel End and Device End in the gap before the Key area. When not chained, Space Count searches for index, clocks over gap 1, Home address, gap 2, and spaces over R0 count. Operation ends in the gap following the R0 count with Channel End and Device End.	Three bytes used as Key Length (one byte) and Data Length (two bytes) for the next command.
Recalibrate	13	Moves the access to cylinder 0 and select head 0.	None
Restore	17	No action. Zero initial status is followed by final status of Channel End and Device End.	
Seek Head	1B	Selects the head specified by the seek address.	Six address bytes. Only the five low-order bits of the sixth byte are used for the seek address.
Set File Mask	1F	Sets file mask to indicate permitted Write, Seek, and diagnostic commands.	One byte of file mask data.
Set Sector	23	Used on disconnected command chaining channels to eliminate the need for the channel to maintain connection with the storage control while waiting for the selected record to reach the head. *Note: If the RPS feature is not installed on the addressed 3340, this command returns Channel End and Device End together in final status. No operation is performed and track orientation is destroyed. All 3344 units have RPS.*	One byte specifies angular track position (0–63)

Control Commands (Continued)

Command	Code	Function	Data Transferred Across Channel
Diagnostic Load	53	Transfers the specified 512-byte block from the read-only storage to the control storage buffer.	One byte of control information addresses one sector on the 23FD.
Diagnostic Write	73	Transfers an inline test from the main storage to storage control and executes the test. A 16-byte error code message is stored in the storage control buffer area. A subsequent Diagnostic Sense command transfers the error code message to main storage; requires a special file mask.	A maximum of 512 bytes.
Device Release	94	Terminates the reservation of the addressed device. Only available for two channel switch, two channel switch additional, or string switch feature machines.	Twenty-four sense bytes.
Device Reserve	B4	Reserves the addressed device for exclusive use when selection is made. Only available for two channel switch, two channel switch additional, or string switch feature machines.	Twenty-four sense bytes.

READ COMMANDS

Command	Code		Function	Data Read
	Single Track	Multi-track		
Read Initial Program Load (See Note 1)	02	–	Recalibrates to cylinder 0 and head 0, searches for index point, and reads R1 data from the drive to main storage.	First data area after R0.
Read Data	06	86	Transfers data area of a record from drive to main storage.	First data area after address marker or the data area of the record that was chained from the count or key area of the same record.
Read Key and Data (See Note 2)	0E	8E	Transfers key and data areas of a record from drive to main storage.	First key and data area after address marker or the key and data area that was command chained from the count area of the same record.
Read Count	12	92	Transfers next count area (8 bytes) from the drive to main storage.	Next record count area or first count area after R0.
Read Record Zero (R0) (See Note 3)	16	96	Transfers R0 (count, key, and data) from the drive to main storage.	Record 0.

Note 1: A Read IPL command cannot be preceded by a Set File Mask command in the same chain.

Note 2: If the KL equals 0, the command is executed the same as a Read Data command.

Note 3: When chained from a Search HA or Read HA command, the Read R0 command is executed immediately and does not initiate a search for index point.

Read Commands (Continued)

Command	Code		Function	Data Read
	Single Track	Multi-track		
Read Home Address	1A	9A	Transfers five bytes (FCCHH) to channel.	Byte 0 = Flag Byte 1 = Cylinder address Byte 2 = Cylinder address Byte 3 = 0 Byte 4 = Head address
Read Count, Key, and Data	1E	9E	Transfers count, key, and data areas of a record from drive to main storage.	Next record or first record after R0.
Read Sector (See Note 4)	22	—	Provides one byte of angular position information which is used by a subsequent Set Sector command. When not chained from a Read, Write, or Search CCW, the byte transferred is the angular position required to access the last record processed on the drive. When chained, the byte transferred is the angular position of the record used in the previous CCW.	
Read Multiple Count, Key, and Data (See Note 5)	5E	—	Transfers remaining records on a track to the channel. In use, this command is the same as a series of Read, Count, Key, and Data commands. Since the number of bytes is unknown, CCW count should be larger than the longest track length. Use the SILI bit to suppress incorrect length indication.	Starts at count field of next record (except R0)

Note 4: Causes loss of orientation.

Note 5: Command Retry works only on single records, so certain types of errors cannot be retried. (The Read Multiple Count, Key, and Data command is supported on 3830-2, IFA, and ISC with 3340/3344 configurations.)

Command	Code		Function	Data Written
	Single Track	Multi-track		
Write Special Count, Key, and Data (See Note 1)	01	—	Same as Write Count, Key, and Data command except a 1 is written in bit 4 of the flag byte to indicate a record overflow segment.	Same as Write Count, Key, and Data.
Write Data (See Note 2)	05	—	Changes the data area of a record.	Data from the system. Writes the number of bytes specified by the DLDL bytes of the count area of the same record.
Write Key and Data (See Note 3)	0D	—	Changes the key and data areas of a record.	Data from the system. Writes the number of bytes specified by the KL and DLDL bytes of the count area of the same record.
Erase (See Note 4)	11	—	Operates exactly like a Write Count, Key, and Data command except that data from the channel is not written on the track.	Bytes of 0s to end of track.
Write Record Zero (R0) (See Note 5)	15	—	Writes count, key, and data areas of R0.	Flag byte from HA area. CCHHRKLDLDL from system written in count area. Key and data from system.

Note 1: Same as Write Count, Key, and Data. Not used for last segment of an overflow record.

Note 2: If file mask is violated, set Command Reject. Must be chained from a successful Search ID Equal or Search Key Equal command.

Note 3: If file mask is violated, set Command Reject. Must be chained from a successful Search ID Equal command. If KL = 0, operation is the same as Write Data.

Note 4: The CU skips writing an address marker, sync byte, or ECC.

Note 5: Same as Write Count, Key, and Data except it must be chained from a Write HA or a successful Search HA Equal command.

Write Commands (Continued)

Command	Code		Function	Data Written
	Single Track	Multi-track		
Write Home Address (HA) (See Note 6)	19	—	Writes the 7-byte (SDFCCHH) home address area on the selected drive and track.	The 7-byte (SDFCCHH) home address area transferred from the system.
Write Count, Key and Data (See Note 7)	1D	—	Writes one complete record on the selected drive and track.	Count, key, and data areas of next record on the track. Data for the areas comes from the system. The count area flag byte, ECC, and gap data come from storage control.

Note 6: Must be chained from a satisfied Search HA (with the CCW count area of four or more) if defective bit (flag byte, bit 6) is off.

If not chained from a satisfied Search HA, defective bit must be on.

Note 7: If file mask is violated, set Command Reject. Must be chained from Write R0; Write Count, Key, and Data; Erase; a successful Search ID Equal; or Search Key Equal command. After last Count, Key, and Data command on a track, write 0s to index.

SEARCH COMMANDS

Command	Code		Function	Data Compared
	Single Track	Multi-track		
Search Key Equal (See Note 1)	29	A9	Locates a key area selected by the system.	The key area bytes from the selected drive and track with data from the system.
Search ID Equal	31	B1	Locates a count area selected by the system.	Five bytes (CCHHR) of the next count area from the selected drive and track with CCHHR from the system.
Search Home Address Equal	39	B9	Locates a home address area selected by the system.	Four bytes (CCHH) of home address area from the selected drive and track with CCHH from the system.
Search Key High (See Note 2)	49	C9	Locates a key area selected by the system.	The key area bytes from the selected drive and track with data from the system.
Search ID High (See Note 3)	51	D1	Locates a count area selected by the system.	Five bytes (CCHHR) of the next count area from the selected drive and track with CCHHR from the system.
Search Key Equal or High (See Note 4)	69	E9	Locates a key area selected by the system.	The key area bytes from the selected drive and track with the key area from the system.
Search ID Equal or High (See Note 5)	71	F1	Locates a count area selected by the system.	Five bytes (CCHHR) of the next count area from the selected drive and track with CCHHR from the system.

Note 1: The key area compared is the key area of the next record (excluding R0), unless chained from a Read Count or Search ID command. If chained from a Count operation, the key area searched is in the same record.

Note 2: Same as Search Key Equal except the key area is located in any key area on the track that is higher than the key area from the system.

Note 3: Locates any ID from the track that is higher than the ID from the system.

Note 4: Same as Search Key Equal except the key area located is equal to or higher than the key area from the system.

Note 5: Locates the ID from the track that is equal to or higher than the ID from the system.

SENSE DATA

The status and condition of the 3340/3344 is reported in the sense bytes. There are 24 bytes and seven different formats, 0–6. Four formats, 1, 4, 5, and 6 describe the disk storage condition. The remaining three formats, 0, 2, and 3 are associated with the storage control. Only the formats dealing with the 3340/3344 are explained in this publication. Refer to the ISC and 3830-2 reference manuals for formats 0, 2, 3, and a detailed description of Unit Status.

Some sense byte formats may vary for the different attachment methods. Therefore, the 3340/3344 user should also order companion manuals in order to have a complete set of sense byte information. The following manuals are recommended for System/370 Models 115, 125, and 135 users:

- *IBM System/370 Model 115 Functional Characteristics,* Order No. GA33-1510.
- *IBM System/370 Model 125 Functional Characteristics,* Order No. GA33-1506.
- *IBM System/370 Model 135 Functional Characteristics,* Order No. GA33-3005.

Sense Byte Summary

In all the formats, the first eight bytes, 0–7, give high-level information concerning status and condition. Sense byte 7 identifies the format in which the remaining bytes, 8 through 24, are arrayed:

Byte 7

- Bits 0–3 = The format array of bytes 8–24

0	1	2	3	Format
0	0	0	1	1
0	1	0	0	4
0	1	0	1	5
0	1	1	0	6

- Bits 4–7 = Define a message.

4	5	6	7	Message
0	0	0	0	0
↓	↓	↓	↓	↓
1	1	1	1	F

Each of the formats 1, 4, 5, and 6 (including the possible messages) is summarized in the charts on the following pages.

SENSE BYTES 0–7 SUMMARY

Byte	Bit 0	1	2	3	4	5	6	7
0	Command Reject	Intervention Required	Channel Bus Out Parity	Equipment Check	Data Check	Overrun	Track Condition Check	Seek Check
1	*Permanent Error	Invalid Track Format	End of Cylinder	Not Used	No Record Found	File Protected	Write Inhibited	Operation Incomplete
2	RPS Feature Present	Correctable	Not Used	Environmental Data Present	Compatibility Mode	Data Storage Type See Note		
3	RESTART COMMAND (Provided only when byte 1 bit 7, Operation Incomplete, is active)							
4	PHYSICAL DRIVE IDENTIFICATION A	B	C	D	E	F	G	H
5	LOW-ORDER LOGICAL CYLINDER ADDRESS 12B	64	32	16	8	4	2	1
6	HIGH-ORDER LOGICAL CYLINDER ADDRESS 512	256	AND		Log Trk 8	Log Trk 4	Log Trk 2	LOGICAL TRACK Log Trk 1
7	FORMAT (bits 0–3 hex)				MESSAGE CODE (bits 4–7 hex)			

* Set by Error Recovery Procedures

	0	1	2	3	4	5	6	7
	**CURRENT SEEK ADDRESS							
OR	**CURRENT SEEK ADDRESS							

If Seek Check active (byte 0 bit 7)

** Current seek address is the last argument (address) issued to the device. Byte format remains the same as above. Always present in Bytes 5 and 6.

Note: Data Storage Type

	5	6	7
3348-35Mb Data Module	0	0	1
3348-70Mb Data Module or 3344	0	1	0
3348-70F Mb Data Module or 3344-B2F	1	1	0

FORMATS 1, 4, and 5 MESSAGE SUMMARY

MESSAGES, determined by format and message code (byte 7)

	Format 1	Format 4	Format 5
0	No Message	HA area data check	Not Used
1	Transmit target error	Count area data check	Not Used
2	Microprogram detected error (See byte 18)	Key area data check	Not Used
3	Transmit Fixed Head error or Transmit Difference High Error (3344)	Data area uncorrectable data check	Data area correctable data check
4	Sync Out timing error	HA area — no sync byte found	Not Used
5	Unexpected drive status at initial selection	Count area — no sync byte found	Not Used
6	Transmit cylinder address error	Key area — no sync byte found	Not Used
7	Transmit head error	Data area — no sync byte found	Not Used
8	Transmit difference error	Not Used	Not Used
9	Drive status not as expected during Read IPL	(3344 only) AM Detection failure on retry	Not Used
A	Seek verification check on physical address	Not Used	Not Used
B	Seek Incomplete or Sector Non-compare	Not Used	Not Used
C	No Interrupt from drive	Not Used	Not Used
D	Defect skipping re-orientation check	Not Used	Not Used
E	DM Incompatibility/ Invalid DM size (not on 3344)	Not Used	Not Used
F	Not Used	Not Used	Not Used
	Format 1	Format 4	Format 5

3340 SENSE BYTE FORMAT 1 SUMMARY

Byte	Bit	0	1	2	3	4	5	6	7	
8	**Drive Status**	Controller Check	Drive Interface Check	Drive Check	Read/Write Check	On Line	Data Module Attention	Busy	Seek Complete/ Search Sector	OR 1
9	**Checks, Status**	Data Module Loaded Sw Lchd	Sector Compare Check	Motor-at-Speed Latched	Air/Belt Switch Latch	Write Enabled	Data Module Size 4 Fixed Head	Data Module Size 2 —70 Mb	Data Module Size 1 —35 Mb	
10	**DM Seq Control**	Data Module Size Check	Data Module Latch 4	Data Module Latch 2	Data Module Latch 1	Check Latch	Data Module Sequence Check Ltchd	Bias Disable Switch	Odd Track	
11	**Load Sw Status**	Drive Start Switch	Data Module Present Switch	Cover Locked Switch	Data Module Unloaded Switch	Data Module Loaded Switch	Air/Belt Switch	Carriage Home	Motor-at-Speed Switch	
12	**R/W Safety**	Multiple Head Sel Switch	Capable/ Enable Check	Write Overrun	Index Check	Read/Write Interlock Check	Control Check	Transition Check	Write Current Check	
13		CONTROL INTERFACE BUS OUT or EXPECTED DRIVE STATUS/DATA (For Message Code C) (If Message Code 2, see Microprogram Messages, Bit 18. Valid for 1, 3, 5, 6, 7, 8, and 9)								OR 2
14			CONTROL INTERFACE BUS IN (At time error was detected) (Valid only for Message Codes 1, 3, 5, 6, 7, 8, and 9).							
15			CONTROL INTERFACE TAG BUS (At time error was detected) (Valid only for Message Codes 1, 3, 5, 6, 7, 8, and 9).							
16	**Access Status**	Access Time Out Check	Overshoot Check	Servo Off-track Check	Track Crossing	Servo Latch	Linear Mode Latch	Control Latch	Wait Latch	
17	**Controller Checks**	PLO Check	No PLO Input Check	SERDES Check	Gap Counter Check	Write Data Check	Monitor Check	ECC Check	ECC Zeros Detected	
18	**Micro Detected Errors**						Coded Error Condition (bits 4—7 hex)			OR 4
19	**Status**	Set Read/ Write On See 1					Lo Gain Error		Fixed Head Feature	
20	**Interface Checks**	Cntrl I'face Tag Bus Parity Check	Cntrl I'face Bus Out Parity Check	Drive Selection Check	Device Bus In Parity Check	Cntrl I'face Bus In Parity Check	Initialize Write Failure	Device Bus Out Parity Check	Device Tag Parity Check	OR 3
21										
22				FAULT SYMPTOM CODE						
23				FAULT SYMPTOM CODE						

1 If Busy is on (Byte 8, bit 6), Search Sector is in progress.
If Set R/W is active (Byte 19, bit 0),
Bit 5 = I Write Sense
Bit 6 = Index Mark
Bit 7 = Active Track

2 If Seek Check is on (Byte 0, bit 7), bytes 13 and 14 are:

0	1	2	3	4	5	6	7
PREVIOUS SEEK ADDRESS (drive location before present seek; bytes 5 and 6)						Low Logical Cylinder	
128	64	32	16	8	4	2	1
	High Logical Cylinder Address				Logical Track Address		
	512	256		8	4	2	1

3 If Seek Check is on (Byte 0, bit 7), bytes 20 and 21 are:

	PRESENT SEEK ADDRESS			Low Logical Cylinder Address			
128	64	32	16	8	4	2	1
	High Logical Cylinder Address				Logical Track Address		
	512	256		8	4	2	1

4 Microprogram Error Messages (Sense Byte 18, bits 4–7 hex)

0	Not Used.	8	Head switch timer expired check.
1	No Tag Valid on R/W Op.	9	Busy missing after seek start is issued.
2	No Normal or Check End on R/W Op or on ECC Op.	A	Incorrect drive selected.
3	No response from controller on Control Op.	B	Not used.
4	Time-out waiting for index or Active track.	C	Not used.
5	ECC Hardware Check.	D	Not used.
6	Multiple or no controller selected.	E	Not used.
7	Preselection Check.	F	Attention Check.

3344 SENSE BYTE FORMAT 1 SUMMARY

Byte	Bit 0	1	2	3	4	5	6	7	
8 **Drive Status**	Controller Check	Device Interface Check	Drive Check	Read/Write Check	On Line	Spindle Attention	Busy	Seek Complete/ Search Sector	OR 1
9 **Checks, Status**		Sector Compare Check	Motor-at-Speed Latched	Air/Belt Switch Latched	Write Enable	Fixed Head Installed	Always On	Always On	
10 **Sequence Control**		Spindle Sequence Latch 4	Spindle Sequence Latch 2	Spindle Sequence Latch 1	Timer Check Ltch	Sequence Check Ltchd		Odd Physical Track	
11 **Load Sw Status**	Drive Start Latch	Guard Band Pattern	Target Velocity	Track Crossing		Air/Belt Switch		Motor-at-Speed Switch	
12 **R/W Safety**	Multiple Head Sel Check	Capable/ Enable Check	Write Overrun	Index Check	Delta IW Check	Control Check	Transition Check	Write Current Check	
13	CONTROL INTERFACE BUS OUT or EXPECTED DRIVE STATUS/DATA (For Message Code C) (If Message Code 2, see Microprogram Messages, Bit 18. Valid for 1, 3, 5, 6, 7, 8, and 9)								OR 2
14		CONTROL INTERFACE BUS IN (At time error was detected) (Valid only for Message Codes 1, 3, 5, 6, 7, 8, and 9)							
15		CONTROL INTERFACE TAG BUS (At time error was detected) (Valid only for Message Codes 1, 3, 5, 6, 7, 8, and 9)							
16 **Access Status**	Access Time Out Check	Overshoot Check	Servo Off-track Check	Rezero Mode Latch	Servo Latch	Linear Mode Latch	Control Latch	Wait Latch	
17 **Controller Checks**	PLO Check	No PLO Input	SERDES Check	Gap Counter Check	Write Data Check	Monitor Check	ECC Check	ECC Zeros Detected	
18 **Micro Detected Errors**						Coded Error Condition (bits 4 – 7 hex)			OR 4
19 **Status**	Set Read/ Write on (see byte 1)				Head Short Check			Fixed Head Feature	
20 **Interface Checks**	Cntrl I'face Tag Bus Parity Check	Cntrl I'face Bus Out Parity Check	Drive Selection Check	Device Bus In Parity Check	Cntrl I'face Bus In Parity Check	Initialize Write Failure	Device Bus Out Parity Check	Device Tag Parity Check	OR 3
21									
22			FAULT SYMPTOM CODE						
23			FAULT SYMPTOM CODE						

1 If Busy is on (Byte 8, bit 6), Search Sector is in progress.
If Set R/W is active (Byte 19, bit 0),
Bit 5 = I Write Sense
Bit 6 = Index Mark
Bit 7 = Active Track

2 If Seek Check is on (Byte 0, bit 7), bytes 13 and 14 are:

0	1	2	3	4	5	6	7
PREVIOUS SEEK ADDRESS (drive location before present seek; bytes 5 and 6)						Low Logical Cylinder	
128	64	32	16	8	4	2	1
	High Logical Cylinder Address				Logical Track Address		
	512	256		8	4	2	1

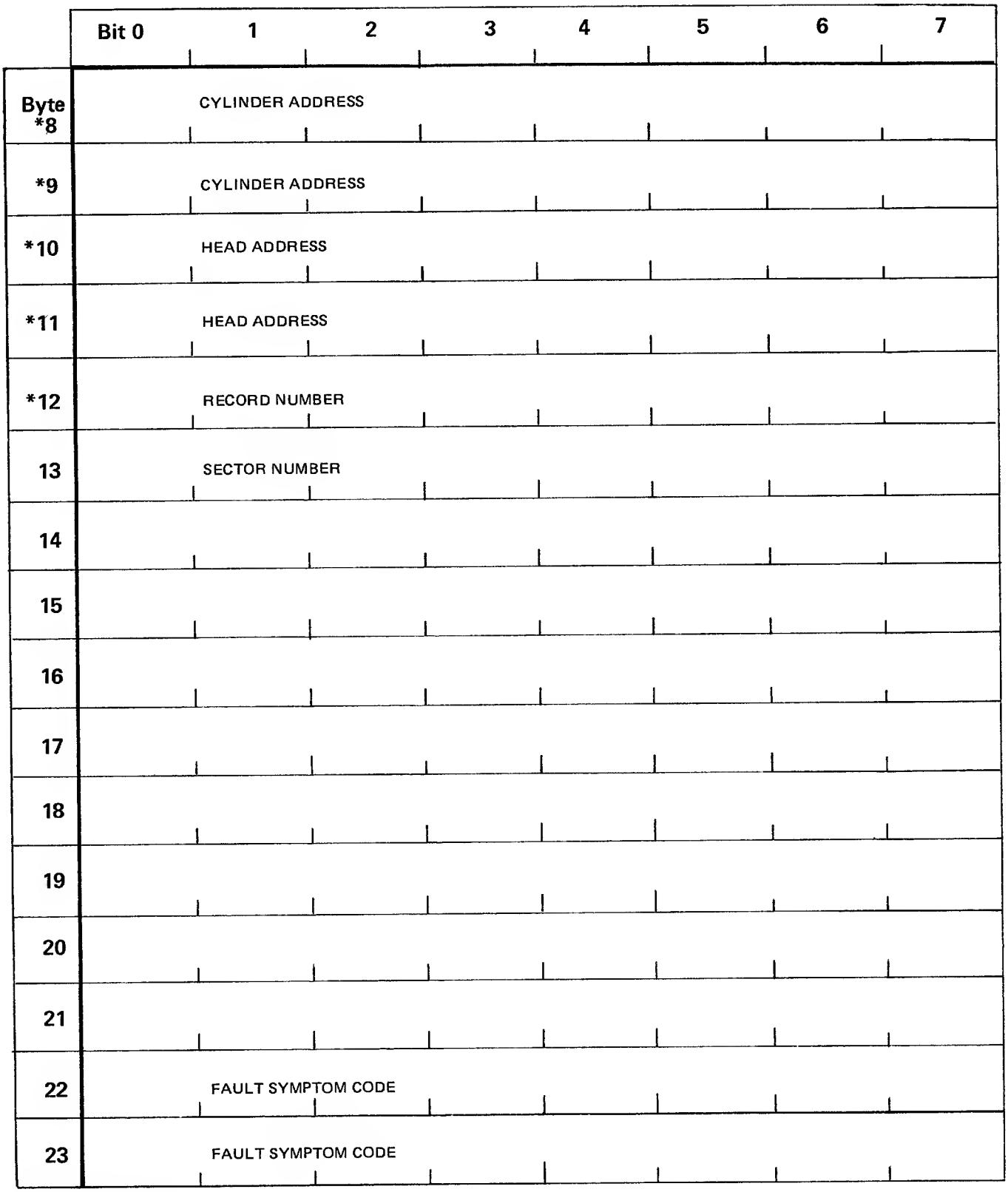
3 If Seek Check is on (Byte 0, bit 7), bytes 20 and 21 are:

	PRESENT SEEK ADDRESS			Low Logical Cylinder Address			
128	64	32	16	8	4	2	1
	High Logical Cylinder Address				Logical Track Address		
	512	256		8	4	2	1

4 Microprogram Error Messages (Sense Byte 18, bits 4–7 hex)

0	Not Used.	8	Head switch timer expired check.
1	No Tag Valid on R/W Op.	9	Busy missing after seek start is issued.
2	No Normal or Check End on R/W Op or on ECC Op.	A	Incorrect drive selected.
3	No response from controller on Control Op.	B	Not used.
4	Time-out waiting for index or Active track.	C	Not used.
5	ECC Hardware Check.	D	Not used.
6	Multiple or no controller selected.	E	Drive at invalid address.
7	Preselection Check.	F	Attention Check.

SENSE BYTE FORMAT 4 SUMMARY



* Count Identification

SENSE BYTE FORMAT 5 SUMMARY

	Bit 0	1	2	3	4	5	6	7
Byte *8	CYLINDER ADDRESS							
*9	CYLINDER ADDRESS							
*10	HEAD ADDRESS							
*11	HEAD ADDRESS							
*12	RECORD NUMBER							
13	SECTOR NUMBER							
14								
15	RESTART DISPLACEMENT							
16	RESTART DISPLACEMENT							
17	RESTART DISPLACEMENT							
18	ERROR DISPLACEMENT							
19	ERROR DISPLACEMENT							
20	ERROR PATTERN							
21	ERROR PATTERN							
22	ERROR PATTERN							
23								

* Count Identification

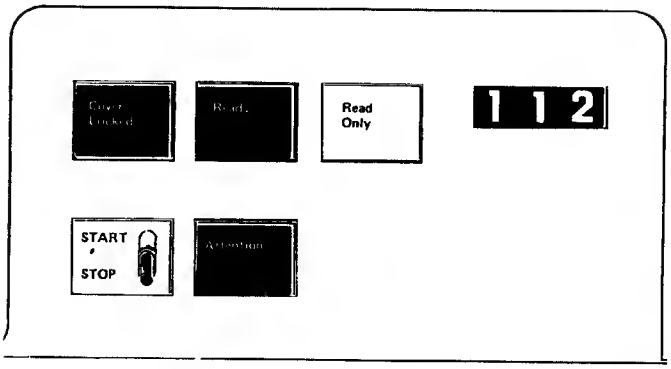
SENSE BYTE FORMAT 6 SUMMARY

	Bit 0	1	2	3	4	5	6	7
Byte 8	NUMBER OF BYTES READ OR SEARCHED (Key and Data Areas Only)							
9	NUMBER OF BYTES READ OR SEARCHED (Key and Data Areas Only)							
10	NUMBER OF BYTES READ OR SEARCHED (Key and Data Areas Only)							
11	NUMBER OF BYTES READ OR SEARCHED (Key and Data Areas Only)							
12								
13								
14								
15								
16	NUMBER OF SEEK COMMANDS PROCESSED							
17	NUMBER OF SEEK COMMANDS PROCESSED							
*18	Channel select for bytes 20–23							
*19								
*20	COMMAND OVERRUNS	CHANNEL A if byte 18 bit 0 is 0 CHANNEL C if byte 18 bit 0 is 1						
*21	DATA OVERRUNS	CHANNEL A if byte 18 bit 0 is 0 CHANNEL C if byte 18 bit 0 is 1						
*22	COMMAND OVERRUNS	CHANNEL B if byte 18 bit 0 is 0 CHANNEL D if byte 18 bit 0 is 1						
*23	DATA OVERRUNS	CHANNEL B if byte 18 bit 0 is 0 CHANNEL D if byte 18 bit 0 is 1						

* Bytes 18–23 Not device-dependent information.

OPERATING INSTRUCTIONS

3340 OPERATOR PANEL



Ready Indicator

Lights when the data module is properly inserted and ready for operation.

Start/Stop Switch

With the switch set to Start, the cover is locked, the data module is loaded and the heads are moved to track 0, provided that:

1. The drive power is on.
2. The data module is in place.
3. The cover is closed and latched.

When the switch is set to Stop, the data module unloads and the cover unlocks. The data module cannot unload while the system is communicating with the drive or with a pending Attention.

Read Only Indicator

Lights when the write function is inhibited after the data module is loaded. Write is inhibited by enabling the Read Only function on the data module.

Cover Locked Indicator

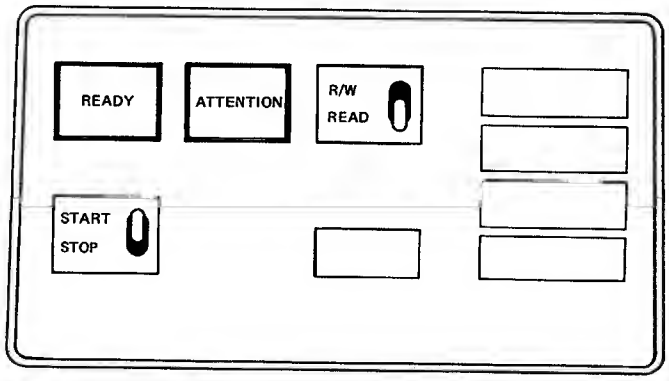
Lights when the drive cover is locked.

Attention Pushbutton

By operating the attention pushbutton the drive begins a Rezero operation:

1. Read/Write heads are moved to track 0.
2. DM (data module) Attention is signaled to the controller.
3. Drive is placed online and CE mode is reset (after maintenance completion).

3344 OPERATOR PANEL



Ready Lamp

The Ready lamp turns on when the drive power is on, the drive speed is up to normal, and the head is on a track.

Start/Stop Switch

The drive Start/Stop switch starts and stops a drive. When set to Start, the brake is released, the disks start spinning, and the heads move to cylinder 0. When set to Stop, the heads retract, the brake engages, and the disks stop. An electrical interlock in the stop position prevents a stop if the drive is busy.

Attention Pushbutton

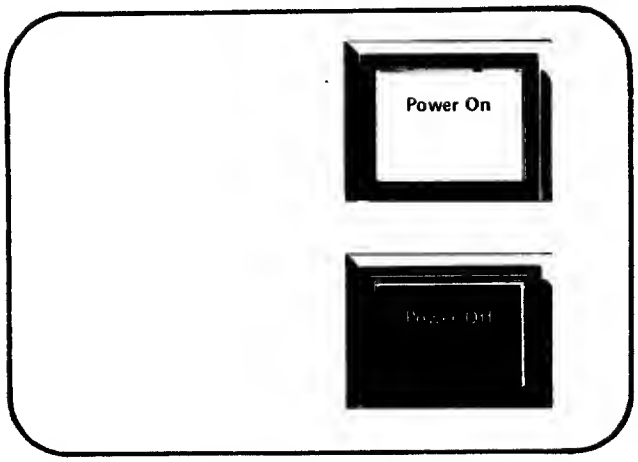
When pressed, the Attention pushbutton starts a Rezero operation. Rezero moves the heads to track zero, resets the address registers, and signals attention to the controller.

R/W or Read Switch

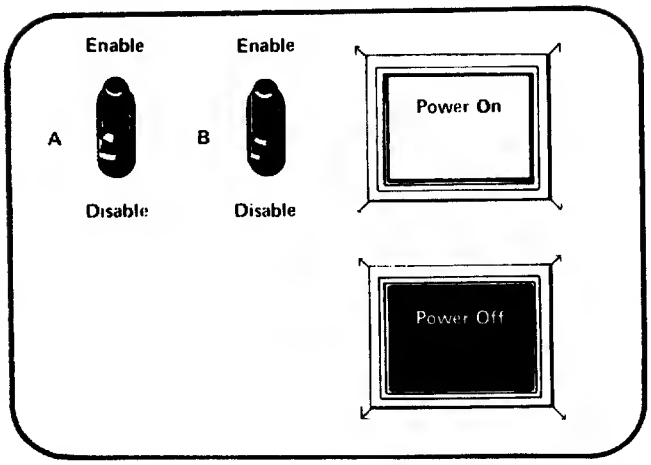
When in the Read position, no write or erase operation can be done. If set to R/W, all normal operations are possible. If the switch position is changed during an operation, the condition does not change until the operation is completed.

3340/3344 POWER PANEL

Machines Without String Switch Feature



Machines With String Switch Feature



Power On Switch

Operation of the Power On switch allows ac power to be applied to the 3340 or 3344 provided subsystem power is present. The switch is bypassed by the sequencing controls during a system power-up operation.

Power Off Switch

Operation of the Power Off switch removes ac power from the 3340 or 3344 when system power is up. During a system power-down operation, this switch is bypassed and power is removed by the sequencing controls.

Note: *Do not use Power On/Power Off switches to load or unload the data module.*

Enable/Disable Switches

The Enable/Disable switches (A or B interface) can be used to dedicate the 3340-A2 and associated drives to a single interface. Interlocking is provided.

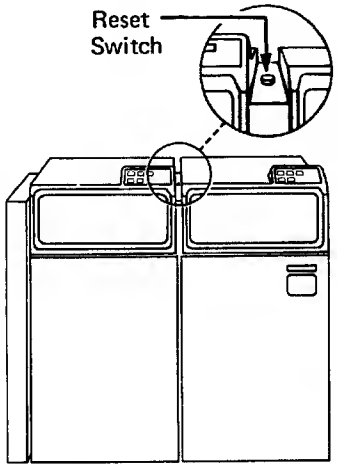
DATA MODULE LOADING

1. Place the Start/Stop switch in the stop position.
2. Open the top cover.
3. With the data module doorway facing the rear of the drive, lower the data module into the drive shroud recess until it is seated.
4. Close the top cover.
5. Place the Start/Stop switch in the start position. The Cover Locked indicator will light indicating the start of the load sequence.
6. The data module is automatically loaded. After 20 seconds, the Ready indicator will light to show the drive is ready. This also forces a Pack Change Device End Interrupt to the storage control.

   Note: *Correct data module loading depends on:*
   a. Proper data module alignment in the drive shroud recess.
   b. The 3340 top cover being fully closed.
   c. The 3348 Model 70F being used only on drives having the fixed head feature. If the Model 70F is loaded on a drive without the fixed head feature, the Ready light indicates ready, but the drive is not online to the system. Intervention Required is set in the sense information.

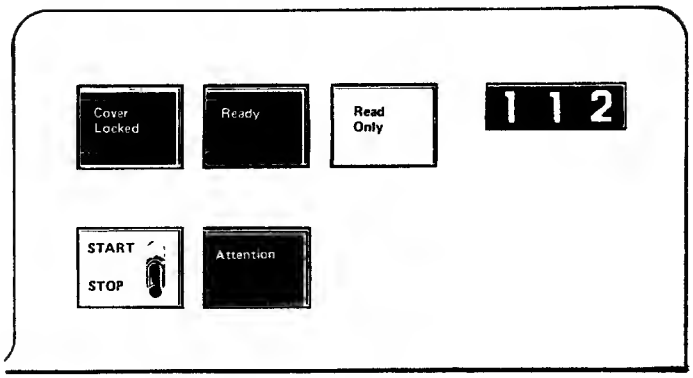
   Fixed head drives can operate with any data module.

7. If the data module fails to load, the Ready indicator does not light. Press the drive Reset switch. If nothing happens, place the Start/Stop switch at Stop and press Reset again. If the drive does not respond, call for customer engineer assistance.

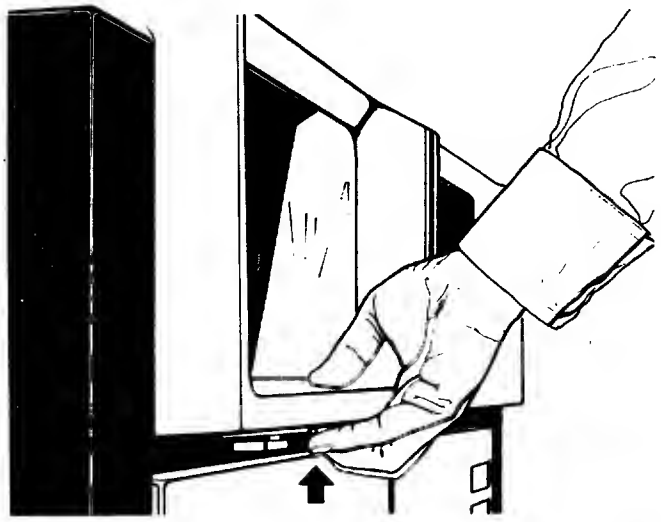


DATA MODULE UNLOADING

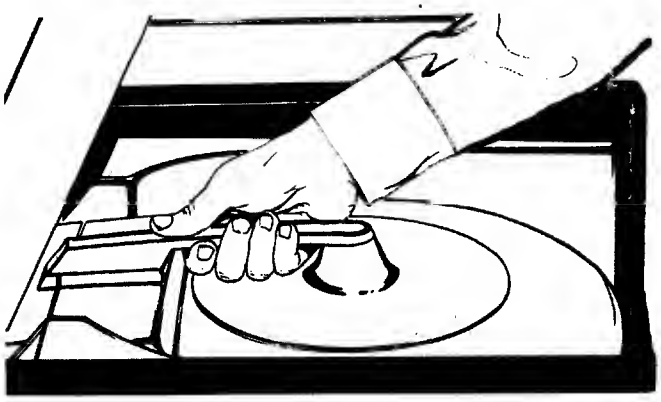
1. Place the Start/Stop switch in the stop position.
2. When the Cover Locked indicator turns off, open the top cover.
3. Lift the data module from the drive.



Operator Panel



Opening Cover



Load/Unload Data Module

READ ONLY FUNCTION

The Read Only function protects previously written data. On the 3344 units a Read or R/W switch, used for this purpose, is located on the operator panel. In 3340 units the means for protecting data is located on the data module.

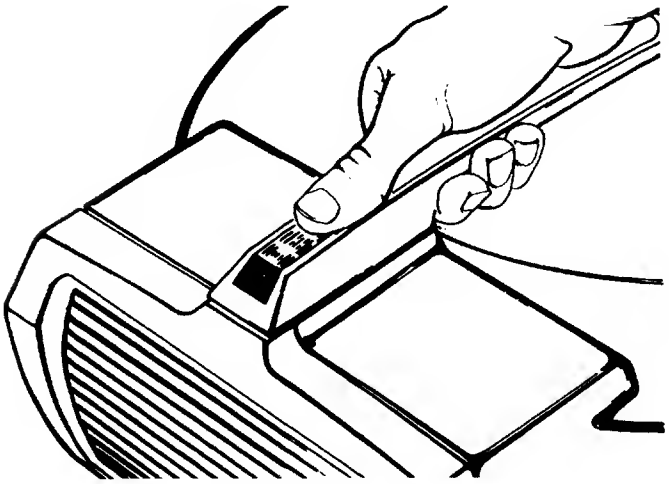
Enable Read Only Function

1. With the data module removed from the drive, press down the IBM logo inset of the handle (A and B).
2. Turn inset 180° and snap into place (C).
3. The data module may now be loaded in the desired drive.

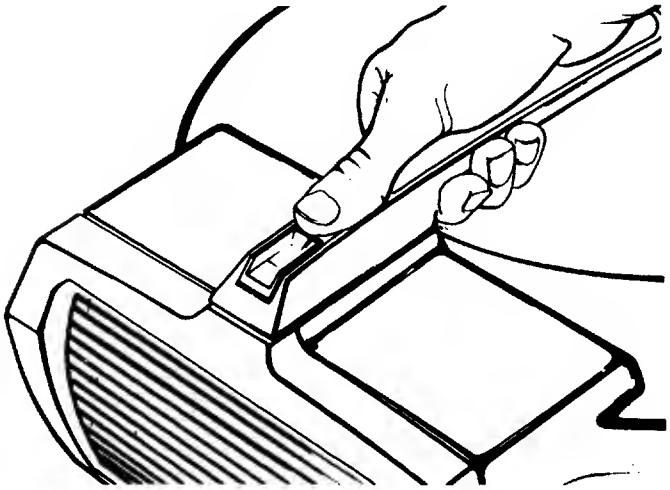
Disable Read Only Function

1. With the data module removed from the drive, return the IBM logo inset to its original position reverse 180° (D).
2. The data module may now be loaded into the desired drive.

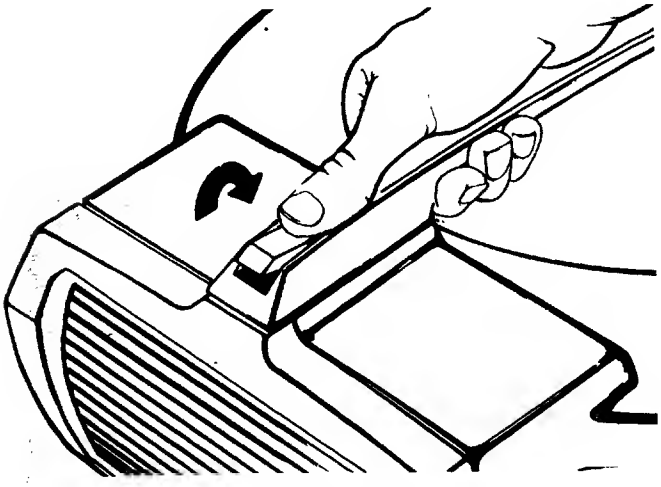
Note: *Do not attempt to enable or disable the Read Only function while the data module rests in the drive shroud recess.*



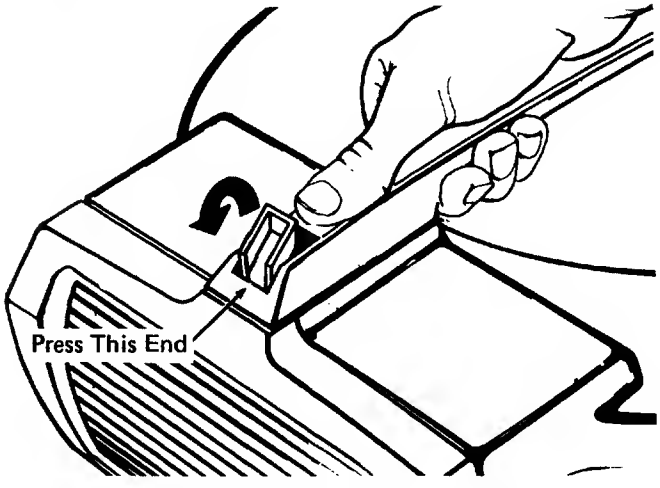
A Read/Write



C Read Only



B Actuate from Read/Write to Read Only



D Actuate from Read Only to Read/Write

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